# AMERICAN RAILROAD JOURNAL

NEW YORK [ETC.]

V. 7, 1838

# AMERICAN

# RAILROAD JOURNAL,

AND

# MECHANICS' MAGAZINE.


Vol. I.—New Series,

OR

**VOL. VII.**

New-York:

PUBLISHED BY THE EDITORS AND PROPRIETORS,

D. K. MINOR, & G. C. SCHAEFFER, 120 NASSAU-STREET,

*(Up Stairs.)*

1838.

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# AMERICAN RAILROAD JOURNAL AND MECHANICS' MAGAZINE.

No. 1, Vol. I.
New Series.] JULY 1, 1838. [Whole No. 313.
Vol. VII.

## TO SUBSCRIBERS.

THE present is the first number of a new volume, and with it we commence a new series, in its present form, and in semi-monthly numbers.

In consequence of the suspension, for several months, of its publication, the present, or *Seventh* volume, will be commenced on the 1st of July—*instead* of January, 1838; and the work will hereafter form *two* volumes each year.

Subscribers who have paid in advance for the work for the year 1838, will of course be credited for one year from the commencement of this volume, or to July 1, 1839, and those who have paid to a period subsequent to the close of volume *Six*, will be credited accordingly.

Apologies for past omissions and delays, or promises of future punctuality, will avail us little, and we therefore simply observe that our best exertions will be used to make the work useful to its readers, who are requested to aid, by prompt payment, in sustaining the work.

☞ Those indebted for *past volumes* are especially called upon to pay the amount due, *or the work will not be continued to them* after the sixth number of this volume.

⁂ The MECHANICS' MAGAZINE, heretofore published as a separate work, will from this date be united with the Railroad Journal, and the publication will hereafter bear the title of RAILROAD JOURNAL AND MECHANICS' MAGAZINE, and be forwarded to those who have paid for the *Mechanics' Magazine* to a period subsequent to *July* 1, 1837, until they shall have received as many months of *this*, as they paid for *that* work—or until otherwise ordered, if paid for in advance.

The terms are Five Dollars per annum, *in advance.*

## ATLANTIC STEAM NAVIGATION.

Seldom has it fallen to our lot to congratulate our readers upon an event of more importance than the safe arrival of two fine English Steamers.

One of these, the *Sirius*, sailed from Cork on the 4th of April, and reached our harbor on the 23d, after a trifling detention at Sandy Hook. Scarcely had our citizens received the intelligence of her arrival, when the *Great Western* came in, on the same day, having left Bristol on the 7th.

Lieut. Hosken, the Commander of the *Great Western*, having made arrangements for her reception, while on a visit to the United States for that purpose, and the probable time of departure of both vessels having been announced in our papers, public expectation was on tiptoe for some time. Our citizens forgot every thing else, and talked only of steam vessels. The impossibility of the passage having been confidently asserted, and attempted to be proved, by men of some note, on the other side of the Atlantic, there was doubt and anxiety in the minds of those not accustomed to study such matters. When the long looked for vessels came, public opinion turned decidedly in favor of the practicability of the passage, nothing having occurred to furnish the slightest ground for uneasiness or alarm, during the trip of either of the vessels; although, the weather being adverse, a severe test of the capability of the steamers was afforded.

To the Commander of the *Sirius*, Lieut. Roberts, R. N., is due the honor of having brought across the Atlantic the first English Steam Packet. This vessel, at present chartered by the company for which she sails, is intended to ply between this port and Cork, only until their great vessel, the *British Queen*, is completed.

Though the *Sirius* is not so large as the last named vessel, still she is of respectable capacity registering about 700 tons. She is sharp, and of a good model for sea use. Her wheel houses are the only projections from her flush sides. She has a comfortable cabin of moderate size, but very neatly arranged and ornamented. Carrying two masts of schooner rig, she can, when necessary, make good use of her sails.

It is of her machinery, however, that we have most to say. The massive character of all that belongs to this department, is immediately noticed by our citizens, who are not accustomed to see such liberal use made of iron.

The engines are after the usual model of English Marine Steam Engines—acting vertically and from a cross head down upon the walking beam (which is nearly level with the bottom of the cylinder), the crank is therefore worked from beneath.

The whole of this is firmly braced and supported by massive iron beams, and secured to a bed plate of great size and weight. By these means, the machinery is rendered compact and firm in itself, without depending upon the strength of the vessel, which may strain ever so much without in the slightest manner affecting the working of the engines, so long as the frame and bed plate are unbroken. In the most violent storm at sea, therefore, the motion is as true and easy as in a river way. The portion of the machinery under the deck is far superior to the arrangement attempted in some of our sea-going boats.

The cylinders of the Sirius are about 6 feet in diameter, while the length of stroke is 7½ feet. This vessel is the first in which we have seen Hall's condensers—with the principle of which our readers are well acquainted from descriptions in the various works on the Steam Engine. By means of this apparatus none but fresh water is supplied to the boilers; the condensed steam, and that which escapes from the safety valves, is returned through the condenser to the boiler, while the small quantity lost by leakage, &c., is replaced by water from a small distillatory apparatus. Great advantages are said to be derived from the use of Hall's Condensers. The proprietor names the following:—The saving in fuel, said in some instances to amount to one-third—the preservation of the boilers, and the time saved in cleaning them—the increase of power derived from the greater perfection of vacuum, the small force required in pumping, and the perfect preservation of the valves of the air-pump—and, lastly, the economy in the size of the boiler, owing to its more perfect condition. Besides these, there are other advantages growing out of the use of various contrivances of Mr. Hall, which are said to greatly increase its adaptation to the navigation of the ocean.

Any saving in fuel will, of course, act with immediate advantage upon the navigation of the Atlantic. It may be thought by some that the saving in fuel mentioned above, is exaggerated; in answer to this, it will only be necessary to remind the reader of the immense waste incurred in blowing out hot water.

We are informed by a gentleman who examined the condensing tubes of the Sirius, that they were in perfect order, and free from any deposite; the boilers from any crust, and the water from any quantity of salt sensible to the taste.

The engines of the Sirius are 320 horse power—we are not informed as to the consumption of coal.

The *Great Western*, commanded by Lieut. Hosken, R. N., is altogether the finest vessel ever seen upon our waters, both as regards elegance of finish, and massiveness of machinery. We pretend not to give our readers a picture of this beautiful vessel—but merely a few dimensions, from which they may be able to ascertain the scale upon which it should be drawn.

Imagine a black ship of 1340 tons—the size of a large man of war—240 feet in length, sharp and trim in the bows, with a round stern of exceedingly graceful curvature—a rounding projection on her sides before the wheel, not inaptly compared to the sides of a large whale—with four schooner-rigged masts, and one immense smoke pipe—and you have the outline of the *Great Western*. On passing over her sides, her deck appears a little world of itself. A fine deck cabin affords a lounging room, and sleeping accommodations for a nnmber of passengers. Through this, and from the open deck are entrances to the main cabin or saloon, the finest apartment we have ever seen afloat; and except by a certain fixedness of its furniture, hardly to be distinguished from the habitations of *terra firma*. No cabin was ever known so high, airy, or finely finished. Parris, the fashionable painter, has decorated the panels with his pencil, while artists of skill in every department, have contributed their share to the decorations of this floating palace. The style of ornament is that of Louis XIV, giving a light and airy, though exceedingly rich appearance to the apartment. The length of this cabin is 82 feet, while a recess on either side gives an extreme breadth in one part of 34 feet. A small additional cabin or ladies' room is also richly ornamented. There is also a fore cabin 46 feet long—affording, with the others, about 130 berths for passengers, with 20 or 30 for their servants. There are also suitable accommodutions for the officers, while a comfortable top-gallant forecastle furnishes ample quarters for the men.

The Engines, built by Messrs. Maudslay, Sons & Field, are of the most massive character and beautiful finish; presenting a truly splendid specimen of British art. These engines are also after the model of English Marine Steam Engines, and all the remarks made in regard to strength, durability, and firmness, while speaking of the Sirius, are still more applicable in this place. The immense beams supporting and connecting the machinery and ponderous masses of iron, are gracefully wrought into gothic arches and columns. The engine room has abundant space for all moving operation, and every thing in and about it is of metal. Some idea of the solidity of the work may be formed from the fact that each paddle shaft weighs 6½ tons, and the intermediate shaft 4½ tons.

These engines are rated at 225 horse power each—the cylinders are 73½ inches in diameter, the length of stroke about 7½ feet. The boilers are 17 feet deep and contain 100 tons of water. They are four in number, and firmly secured, though without contact with each other or with the sides of the vessel; and are so entirely surrounded with metal as to defy danger from fire.

There is a peculiarity in the wheels of both these vessels, worthy at least of the attention of our builders, if not of their imitation. The wheel is that patented by Galloway, and owned, as improved, by Morgan. It goes indifferently by the name of either. It is well known, that the patent as first taken out, was for a feathering wheel, the paddle boards being made to *enter* the water perpendicularly, and retaining at every point of their revolution the same direction to *emerge* from the water perpendicularly. The great saving of power, and other advantages attendant upon such a motion, are obvious to every one, but the difficulties arising from the complicated mechanism were so great, as to prevent the successful introduction of the wheel, as first patented. The form was changed—the paddle boards were fixed upon the arms, but each board was divided into three parts, and these were placed at an angle with the arm and parallel to each other, like a Venetian blind. The paddle boards being permanent, there is no more difficulty in keeping them in order than those used with us. It is this wheel that is used in the Great Western and Sirius. The ease with which the wheels move is very evident; the Great Western does not splash and lift near so much as our smallest boats. The introduction of this contrivance into our steamboats is greatly to be desired—we shall refer to the subject in a future number.

At an entertainment given on board of the Great Western, by the Commander and Consignee, in behalf of the owners, several of our most distinguished citizens were present, and bore testimony to the success of the experiment. Among these were the Hon. Daniel Webster, Gov. Mason, of Michigan, Luther Bradish, ex-Speaker of the House of Assembly, as well as most of our municipal officers.

We have seldom seen so much enthusiasm and good feeling as was shown upon this occasion. Among others, James Buchanan, Esq., the British Consul, addressed the company. He alluded to the rapid transit from Bristol to this city, and hence by railroad to the Mississippi. Gov. Mason also referred to the same subject. John Ridge, a Cherokee Chief, in an elegant address, set forth the situation of his people and the influence of modern improvements upon them. From his distant home beyond the Mississippi, a few days would bring him to join in festivity with those who have almost as recently left England.

The healths of Lieut. Hosken and of Lieut. Roberts were drank with great enthusiasm, as were also many other toasts.

Several of the passengers came forward, and testified to the excellence of the vessel, the superiority of her machinery, and the courteousness of her commander.

Lieut. Hosken took advantage of the opportunity to explain in regard to the injustice that had been done, by scandalous reports circulated before the Great Western left England—even the story of her having been burned to the water's edge was told, to prevent persons from taking passage. Lieut. Hosken invited the strictest scrutiny into the condition of the machinery, &c. Any one was at liberty to examine the state of the worst of the four boilers. The passengers had been allowed every opportunity of witnessing the performance of the engines, and determining for themselves the merits of the case. Lieut. H. also explained, that the machinery was new, had never made but a short trip on the Thames and around to Bristol—that still everything had worked well, though laboring under the disadvantage of a heavy sea at starting, and which continued for several days. No delay however, occurred, except altering a few screws in the bearings to relieve the friction, which occupied but a few minutes—and when advantage was taken of a favorable spell to tighten the paddle boards, as these are numerous, this occupied two hours—with this exception, and when the South America was spoken, the engine was kept constantly at work.

A very gratifying announcement was made by Lieut. Hosken, viz., that the experience of the voyage would enable himself and officers to accomplish a saving of one-fourth of the fuel consumed in a given time.

It was also stated that invitations had been given to several officers of our navy, to accompany the Great Western on her trip out, and that furlough had been granted them for that purpose.

It would be useless for us to attempt to describe the sensation created by the arrival of these vessels—thousands crowded to see them, and tens of thousands to witness their departure.

The obvious advantages to be derived from a speedy passage between this and England, have been immediately seized upon in various quarters, and extensive arrangements are now being made dependent upon Atlantic Steam Navigation.

We need only remind our readers of the immense number of letters to be carried—the greater security in the consummation of mercantile transactions—and the very great saving in the interest of transported specie, to open to their view a wide field of contemplation.

We have neither space nor time to pursue the subject—in our next we shall give further information.

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## PATENT SAFETY FUZE.

We call the attention of Engineers, and others, engaged in public works, to the advertisement of the *Patent Safety Fuze*, which is found on our cover. The increased safety and certainty of its operation render it highly important. We have heard it highly praised by an Engineer, who having had much blasting to do under water, had an excellent opportunity for testing it. In dry work it is also far superior to the ordinary priming—there being no needle to be withdrawn, time is saved, no danger is incurred, and there is a certainty of their discharge. We daily hear of the loss of life by careless blasting; much, if not all of this, might be prevented by the use of the Safety Fuze.

The Manufacturers are confident as to the value of the article, and have, in every instance, submitted it to the severest trial.

The same article is used in England, and by some extensive contractors, to the exclusion of every other thing of the kind. They speak highly of its safety and certainty—items richly repaying them for the small additional expense of the Fuze as sold in England. It is afforded here at an exceedingly small rate, and only wants to be tried to become universally used.

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### *Relative Value of the different kinds of Steam, from different Liquids, as a Moving Power. By* J. A. ROEBLING, *Civil Engineer.*

IN considering steam as a mechanical agent, it is natural to enquire which kind of steam requires the least application of heat to produce a certain effect? This question occurred to me, when I was reading the substance of two Lectures on the Steam Engine, delivered by Dr. Lardner before the Liverpool Mechanic's Institute. Dr. Lardner's remarks, referring to the subject, are as follows:—

"When all those great effects are attained by the mere fact of our availing ourselves of the simple physical effect of converting water into vapor and back again, we naturally say, where there is so large a field and so many different substances, from which the effect may be produced, should we not expect from the large advances which are making in the generalization of their principles, that this effect may be produced from other substances? Water possesses several properties, which render it the most hopeless and unfit for such an experiment. In order to convert it into vapor, we of course apply heat. The least promising liquid is that which requires the largest application of heat; and of all liquids water consumes the largest quantity of heat, requiring nearly 1000° to raise it from a boiling state to a state of vapor; therefore, *a priori*, a philosopher would say, try spirits of wine, or a thousand other things, but do not try water, for this special reason."

So far, the Doctor. I hardly need to mention, that when other liquids in place of water are substituted, condensers, constructed on the principle of Hall's, are to be used. For Locomotives similar condensers could be contrived, where the cooling surfaces are kept cool, by a constant stream of fresh air, produced by an airfan, provided the steam used is of little specific heat.

It is unknown to me, whether Dr. Lardner has made any satisfactory experiments which have enabled him to test the relations of the different kinds of steam, and he does not quote the experiments of other philosophers which would justify the above supposition. This subject has been a matter of serious reflection with me, and since I believe that Dr. Lardner's notion is erroneous in this respect, and because his opinion might entertain the hopes of many who believe that the steam engine is capable of great improvement in this respect, I offer my views to the public, and I shall feel indebted to any one, who, by actual experiments and well-ascertained facts will be enabled to correct my statements, or to refute them altogether.

Being seriously engaged in improving and extending the use of steam, principally to agriculture, it is of great importance to me, whether the bulky weight attending the use of water and coal in Locomotive or Marine Engines, can be greatly reduced or not, by the application of another liquid in place of water. My remarks, however, are confined to the use of Steam, and to the Steam Engine on the common principle, and when heat is applied. I am well aware, and I have good reasons myself to believe, that Dr. Lardner's predictions, regarding the superversion of steam by other natural powers, will be realized sooner or later. Before this however is done, it will be well to exert our reflecting faculties in improving the application of steam power as much as it is capable of improvement.

Water requires about 1000° of heat to be converted from the boiling state into vapor of one atmospheric pressure. This quantity of heat is absorbed by the water, without being raised in its temperature, as far as the temperature has any effect on the thermometer. This absorbed, but not sensible heat, is called *latent* heat, or *specific* heat; and this heat serves to expand the liquid and to increase its volume many fold. When the liquid is not confined, but boiling in an open vessel, and when the barometer is at 28 Parisian inches, and the air in a moderately dry state, then the water cannot absorb more than about 1000° of heat, and the generated vapor will rapidly expend. When the boiling water is confined, it will absorb more heat than 1000°, and the steam generated in the vessel will acquire a greater specific heat, but it will at the same time become proportionably denser, or specifically heavier, and in consequence of this, it will require a greater expansive force; such steam is called high steam.

Steam of the temperature of boiling water has not exactly the same expansive force as the atmospheric air, as is commonly believed. It is a natural law that the different gases and steams penetrate without removing each other, and without effecting a mutual pressure; hence, the steam rising from boiling water is not repelled by the pressure of the atmospheric air. The steam is only repelled by those vapors of the same nature, which are already diffused in the air. Only the gases and vapors of the same nature repel each other by a mutual expansive pressure. The expansive force of the rising steam, therefore, depends on the expansive force of that portion of steam already in the air, and the pressure of which must be overcome. This property of the steam is mentioned by the way, having no strict reference to my subject.

The specific density, now, and the expansive force of steam is depending on its temperature; but the temperature, specific heat, or density, is very different in different kinds of steam of the same pressure raised from different liquids. According to the experiments of Mr. Desprets, water requires in the boiling state, for being converted into vapor of one atmospheric pressure, a quantity of heat very near to . 970°

| | |
|---|---|
| Alcohol requires . . . . . . | 373 |
| Vitriol Ether requires . . . . | 164 |
| Sulphur Alcohol requires . . . . | 145 |
| Spirits of Turpentine requires . . | 137 |

The same quantity of water requires, therefore, 2·6 times as much heat as the same quantity of Alcohol, and seven times as much heat as the same quantity of Spirits of Turpentine requires for being converted into vapor of the same pressure. There is the ostensible reason why Dr. Lardner recommends the substitution of other liquids in place of water.

According to the experiments of some eminent philosophers, when the specific weight of atmospheric air is put equal to . . . 1·0000

| | |
|---|---|
| The specific weight of the low steam of water is equal to | 0·6235 |
| The steam of Alcohol, . . . : : . | 1·6133 |
| The steam of Spirits of Turpentine, . . . . . | 5·0130 |

The steam of Alcohol, therefore, is 2·6 times as heavy, and that of Spirits of Turpentine about 8 times as heavy as the steam of water.

From this it appears, and it is ascertained by a number of experiments, that any fluid, when in a boiling state, requires the less heat for being converted into vapor, the greater the specific weight or the density of its steam is, or the less the steam becomes expanded. Water, when evaporated, will greatly increase its volume, and all the vapors of Alcohol, Spirits of Turpentine, or other liquids, will relatively fill volumes very near proportionally to their specific weight or density. Now, since water, when evaporated, will expand about 1700 times, the steam of Alcohol will expand 655 times, and that of Spirits of Turpentine will only expand 213 times. For producing a certain mechanical effect, now, we want the *same voluminous quantity* of steam of the *same pressure;* the steam may be raised from water, Alcohol, or Spirits of Turpentine. The above statements show, that the same *voluminous quantity* of steam of the same pressure, raised from any liquid whatever, always requires the same quantity of heat, or very nearly so; hence it follows, that there will be no saving of fuel in substituting any other liquid in place of water.

That liquid will be the most economical and advantageous, which, as steam, expanses most: Water, therefore, will be preferable to Alcohol, and Alcohol will be preferable to Spirits of Turpentine; because of the former a less quantity is required than of the latter for producing a certain effect. Besides this, water is cheapest.

I know of no experiments, by which the expansion of the steam of Alcohol, Spirits of Turpentine, &c. had been ascertained by actual measurement; and in the case some have been made, I should like to be informed of it, and whether the results have been found at variance or not with the above deductions.

*Saxenburgh, Butler Co. Pa.*

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## *Interesting Account of the Operation of Cram's Pile Driving and Cutting Machine.*

To the Editors of the Railroad Journal.

*Syracuse, April* 11, 1838.

Gentlemen,—The work on this Road is progressing very favorably. The line of the road being, for the whole distance, in the immediate neighbourhood of the long level upon the Erie Canal, is very favorable.

It is intended to found the road upon piles for about 29 miles. This occurs over level tracts of low, soft land, where the piles are driven from 8 to 12 feet, and being cut off near the surface, they present a uniform and perfect grade.

The manner of driving them is new and highly interesting. The work is done by a steam engine, which raises two heavy cast-iron hammers; elevating them about 30 feet. The piles driven, stand lineally 5 feet apart, and are in two lines under the rails; of course, the distance of the two roads apart, is the proposed width of the track. The machine moves upon the piles that it has driven. In front, between the two hammers and the leaders in which they run, is a circular saw of 40 inches diameter. This saw is regulated in height by screws, and runs in a plane corresponding with the grade of the road. After the two piles are driven to a sufficient depth, the saw is set in motion, and being pressed by an iron rod against one pile, it cuts it off with great force and rapidity; and is readily, by a slight effort, swung against the pile upon the other side, which is in like manner cut off. The work of levelling the saw, and cutting off the piles, is rapidly performed. A flat iron bar is then laid across these two piles, a piece of cast iron rail taken up from behind the machine, on each side, and carried forward to the two last piles sawed off, and rested upon them and the next pile back. Upon this the whole machine is easily rolled forward five feet; when with a pair of grappling hooks at the end of ropes running upon sheaves at the top of the leaders, a pile is taken up at any distance within 60 feet of the machine, and brought at once to its place, properly elevated, between the leaders, and the bearers which have been before raised and fastened, are let down upon them, striking about eight blows per minute.

The machine in operation near this place is worked by a rotary engine from the shop of Messrs. Elam Lynds & Son, and is now driving piles from 24 to 28 feet deep, driving one upon the top of another, or double piles.

The company have *four* of them upon the road distributed along upon the different piling sections. Each machine is operated successfully by eight men, and will in fair average weather and circumstances, drive about a mile of road in a month.

The height at which the piles are sawed off, is regulated as often as required by the levelling instrument, and furnish as perfect a grade as is possible to make. The piles are not less than 12 inches in diameter at the large end, and are necessarily very substantial. The superstructure is laid upon them, consisting first of a cross tie of the best white cedar, 4 by 12, laid flatwise, and then a pine rail 8 inches square. The iron bars are to be laid upon the centre of the rails, on oak ribbons two inches thick. It would be difficult to find any way in which eight men could grade a mile of railroad in a month so perfectly as this is done. The frost, it is supposed will not raise them, and therefore the repairs upon such a road are necessarily slight. The grade of the road will be filled up about them principally from the side ditches.

The only question about them is, as to their durability, and should they last no longer than the common duration of timber, it is a most economical mode of forming the grade in the first instance, leaving the embankments to be made deliberately, and full time to settle. Besides they would decay but a small distance into the ground for many years, when they might be cut off and another one rested upon them. But we are well convinced, *here*, that we can make them endure for any reasonable period, by salting them. It is intended to put a considerable quantity of salt into the head of each pile, and to calculate for as frequent a renewal of the supply of salt as may be deemed necessary. That salt will completely preserve timber from decay, no matter how exposed, has been satisfactorily shown here, in many instances. I lately noticed an instance that had occurred in Herkimer County, where a correspondent of Judge Buel, of the Cultivator, says, that in the spring of 1822, he set some sawed *hemlock* fence posts, one-half he salted by boring a hole a little above the ground diagonally, and filling it with salt, and then plugged it to exclude the air and water.

In the spring of 1830 (eight years), the parts *not salted* were all entirely decayed below the surface of the ground. The salted parts are all now standing (January 10, 1838), and to appearance may stand years longer.' The piles upon which the salt rails here are founded, though small and driven by hands, do not decay, nor does the post raise them so as to affect the rails. I have the most entire confidence in their being preserved by the use of salt. This will, then, be the cheapest and most durable kind of railroad that can be constructed, and in the continuous prairies of the western country, if timber can be found, will be the plan upon which to build their roads.

Many gentlemen have examined the operations of our machines, and have expressed a uniform approbation of the principle. It was patented to Captain Smithe Cram, to whom, and E. P. Williams, now in the employ of this Company, the patent belongs.

These machines, and their operations, can be examined easily during the ensuing summer, as they will be worked at short distances from the Canal, and much of the time in sight of it. Very respectfully, yours,

John Wilkinson.

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## *Long Island Railroad.*

[We are glad to hear again from S. D. The communication has been on hand some time, but has not lost its value. Always impressed with the importance of the continuation of the Long Island Railroad, we deem the present time the very best in which to direct attention and interest to it.]

To the Editors of the Railroad Journal.

*Boston, March* 20, 1838.

Gentlemen,—There is one class of society for which railways may be said to be peculiarly made; a class whose immense daily increase is, perhaps, one effect of the mechanical discoveries which distinguish this age from all others; and that is, the class of men of business, properly so called; that is, of men of business habits, of men of method. As profits become moderate, liable to less fluctuation, peace being every day more valued—as new countries become peopled, and sudden and unlooked for and violent means of rising to eminence or riches cease to exist, such men must increase; and according as civilization extends, and the value of knowledge not as a means of display, but as a means of return is understood, method being one great arm of all such knowledge, such men must increase; and the habit once formed will border upon scrupulousness. To such men, and all men living for a constant object, *railways* will become the favorite mode of conveyance; it will be the mode—when perfected, as it is not now in this country—and the only mode, on which they can rely with some security, on which they can calculate to hours and minutes; which, unlike steamboats, or canals, or ordinary roads, is in a great measure independent of the contingencies of wind and weather, of fogs, of frosts, or of freshets—how much more so, at least, than any other means of conveyance, must be palpable to every one. This mode, therefore, will become the stay of such men—they will find it their interest to suggest it; the other modes may occasionally equal, probably, never surpass it. But the other modes will be desultory in their rates, sometimes rapid, sometimes slow—not to be regularly depended on—interrupting far more the schemes and plans, rules and arrangements, and expectations and predictions of business men—they will always continue more or less erratic in their returns, from their very nature, and they will in their best times, unless no other mode of conveyance presents itself, be especially supported by the erratic, and the luxurious, and migratory of the community; a race sufficiently happy and delightful to mix with, but not the race which governs the mainsprings of industry and enterprize, and upon which all great transactions ultimately depend.

I have been led just now to these expressions, however common-place, while considering the interruption to the steamboat navigation of the Sound this season, when the extreme mildness of the weather might have led us, this time, to expect an exception. The interruption to the travel between Boston and New-York is, it will be admitted, a great drawback. It has occurred more or less every season since I, who have not long however attended to the navigation, can remember. These cities are therefore somewhat estranged during the winter—they shake hands in summer, and in winter their energies are comparatively dormant—were they nearer each other, or in more constant and certain communication, which is the same thing, would not their strength be united, at least, far more so than now. This leads me naturally to advert to the long-talked of Long Island Railroad, which it seems has been commenced, at any rate, though in what way, at present I am unable to say, but let that be as it may, I look upon this road when completed, as reducing vastly the difficulty which is experienced during the winter season, in moving between, or forwarding any thing between these cities; and not less, the uncertainty which exists more or less at all seasons—this uncertainty during the opening and summer months, is to a merchant nearly as annoying as the entire interruption occasioned every winter. There would still remain a portion of the Sound to be navigated, even were the road completed; to wit, between Greenport, or that neighbourhood, and Stonington; but it would ill become us to despise the advantage which upwards of 100 miles of land communication presents over as much sea, because we cannot realize a perfect communication. With the aid of some additional lights, the remaining navigation, or the ferry as it might be termed, would be but rarely interrupted. Familiarity with the passage, with the tides, and with the ground, would render the crossing even during foggy weather sufficiently safe, though it might not be so rapid—we should have escaped the Hurlgate, the place where the ice first accumulates, and first interrupts the trade; and the probability of interruption would be reduced during the most stormy seasons to a sheltered passage, for either side of Plum Island might be taken, on a distance of 26 miles. But the increased certainty as to time, not to dwell on the corresponding economy—the reliance which could be placed on the arrivals within an hour, is a benefit which I am inclined to value very highly, even admitting that an occasional non-arrival did occur in winter. The ferry at Stonington is the only point on the route where (excepting accidents) time can be lost, and here the loss of time would rarely exceed half an hour—an hour's additional time, at any rate, would be a great allowance on so short a distance. We should then be able to accomplish the whole route between New-York and Boston in eleven hours with ease. If I were to take advantage of the occasional rapidities of the Stonington and the Boston Roads, I should say ten, but eleven would be a fair average. We might calculate daily with great safety on the arrivals within twelve hours. Our calculations at present, unless in midsummer, are very little to be depended on.

While there is much to be said in favor of the completion of the Long Island Railroad, and the advantages which it would offer to the inhabitants of the two greatest cities in the Union, there can nothing be said in disparagement of the present means of communication by steamboats, which is not applicable to such conveyance every where. The evil adverted to is inseparable from the element on which they act. These steamboats have, probably, arrived very near perfection in their accommodations, in their civilities, and most of all in their rates of speed. They will always, probably, continue to be used for the conveyance of heavy goods, but the sooner the Long Islanders admit of our dispensing with their accommodations for passengers, the sooner will the public be entitled to add them to the list of its benefactors.

New-York, however, is relying at present too much on her immense natural advantages. She is supine and sluggish in this one respect—careless of public improvement for their own sake.

Very respectfully, **S. D.**

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## *Removal of the Sabine River Raft.*

[We are much indebted to Lieut. Blanchard for the annexed account of the removal of obstructions in the Sabine River, by the force under the command of Major Belknap. It is interesting, as it shows at how small a cost great lengths of our western rivers can be rendered navigable, and open intercourse with immense tracts of country at present no better than a wilderness. Iron Steamboats should be used on the Sabine; it is, as far as we understand the character of the river, a most suitable place for their use. We should feel greatly obliged by any further notices of these improvements; their importance attracts much attention and interest in the progress made in them.—Eds. R.R.J.]

To the Editors of the Railroad Journal.

*Camp on Lake Sabine, La., April* 1, 1839.

Gentlemen,—As I have been engaged in a work of *improvement*, perhaps a short notice of it may be acceptable.

In July last, Major Belknap, 3d Regiment U. S. Infantry, left Fort Jessup, La., with two companies, and marched to the Sabine River, and encamped there until the last of September. The summer was employed in contsructing boats for the descent of the river. In going down, the leaning trees and the snags were cut off, so that with a rise of three feet the river would be navigable. The river was fortunately very low, so much so, that the boats, although light, were sometimes delayed a day in getting a few miles, but it was all the better for our object. From the town of Sabine, on the Texas side, which is about 20 miles below Gaines Ferry, to the *Raft*, a distance of about 200 miles, no obstructions were found to high water navigation, except the snags or leaning trees, which were removed. The Raft was formidable to look at, extending with intervals for a mile, but our active commander succeeded in making a clear passage through it, and it is now a good part of the river. From the *Raft* to the *Narrows* is a fine river, with few leaning trees and snags. The Narrows are about 50 miles from the mouth of the river, and are above 20 miles in extent. The river here branches into three forks, and as the name indicates each fork is very narrrow, not exceeding 30 yards. The fork which we descended was crooked and blocked by falling and leaning trees, but we were successful in clearing a passage for our boats, and for steamboats. From the *Narrows* to the Lake there is a fine broad stream. By this operation the Government, at the slight expense of $1200, has opened a navigation of 300 miles up the Sabine River, and it will have a beneficial influence on the rich lands bordering it.

In proof of the complete success of this work of Major Belknap, I have to state that the Steamer Velocipede, Capt. J. Wright, burden 133 tons, 125 feet long, has lately ascended and descended the Sabine River, as far as the town of Sabine, from whence we commenced our operations, without the slightest injury to any part of her. The boat is too large for the river, but of course *this* proves the practicability of the navigation.

With respect, your obedient servant,

A. G. Blanchard, *First Lieutenant*, *3d Infantry.*

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## *Beet Root Sugar.*

[We are favored with permission to publish the following letter. We are glad to see that our countrymen are taking hold of the matter in the right way. Bring it down to the use and practice of every farmer, and it will do well.—Eds. R. R. J.]

*Boston*, *April* 30, 1838.

Dear Sir,—Some time since, Mr. Breck put into my hands a letter from you, enclosing copies of two letters received from England, detailing the fact of a patent having been taken out for the manufacture of Beet Sugar, by an improved process. Of course we are unable to conjecture what this new process is; but I have the pleasure to state to you, that a gentleman in this vicinity, after ten years' experimenting and close application to this business, has perfectly succeeded in discovering a method of obtaining the sugar, which promises great advantages. The following are some of the results, which may be safely calculated upon.

1. The Beet, a raw material, is so prepared that the manufacture can proceed at any season of the year most convenient.

2. Ten per cent. of good sugar can be obtained from the raw beet; or, in fact, all the sugar it contains, or that can be had by any process.

3. The sugar is obtained by a simple and not expensive method; and is a good article for use without being refined. I have sent a very small sample to-day to Jas. G. Birney, Esq., in New-York, and enclose you the remainder of what is in my possession, knowing the interest you take in

the subject. I should be very glad if it should come in your way, that you would show it to my friend, D. K. Minor, Esq., Railroad Journal Office, Wall street. The sample I send is a fine result.

4. The method requires little time, and no expensive machinery. Every farm house is already in possession of almost all that is necessary.

5. It can be produced at a rate which, at present prices of labor and sugar, is likely to pay one hundred per cent. profit.

6. The specifications are in the way of being sent to the Patent Office; and the right of manufacturing will probably be sold to our farmers, for perhaps ten dollars, or less.

I look upon this as a most important discovery, and I see at present no reason to question its success. Respectfully, yours,

*Anthony Dey, Esq.* HENRY COLMAN.

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## *Genesee Valley Canal.*

[The following letter from Mr. Mills, will give our readers some idea of the progress of an important State work—the Genesee Valley Canal. —See advertisement on the cover.]

*Rochester, May* 3, 1838.

DEAR SIR,—I enclose you one of our Genesee Valley Canal notices of a letting.

When the work embraced in this notice is let, we shall have 52½ miles of Canal under contract, all of which (excepting locks No. 9 and 10, and the Genesee River aqueduct, which are to be done in the fall of the same season) is to be completed in the spring of 1840. The completion of the above work will furnish a canal navigation from Rochester to Mount Morris, a distance of 37 miles on the main line; and from Mount Morris to Dansville on the side cut, 15½ miles. It is designed to prepare the remaining 75 miles, extending from Mount Morris to the Allegany River, for contracting as soon as practicable. I have now two efficient parties of Engineers actively engaged in this service. The Canal Commissioners will definitively locate the line in the month of June, and in the course of the season put the larger portion, if not all of it, under contract. The whole work is to be pressed on vigorously until completed.

I am, very respectfully,

Yours, &c. FREDERICK C. MILL.

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## *Resolutions adopted by the President and Directors of the James River and Kanawha Company, on the 18th January,* 1838.

Resolved, That the President and Chief Engineer be instructed, as soon as the season will permit, to cause the line of Canal from Lynchburgh to the Blue Ridge Canal, to be located and prepared for contract.

Resolved, That they cause also an accurate survey and estimate to be made of the line of Canal from the Eastern extremity of the Blue Ridge Canal to the town of Covington.

Resolved, That they also cause surveys and examinations to be made with a view to the best location of the Railroad from Covington to the Kanawha River, together with an estimate of the cost of the Railroad.

Resolved, That they cause surveys to be made of the line between Covington and the Falls of Kanawha, by the way of Dunlap's Creek, Forkrun, Howard's Creek, Greenbrier River and New River; the line by the way of the South Fork of Dunlap's Creek, Indian Creek, and New River; and the line down Second Creek from the point where the last mentioned line crosses the same, to Greenbrier River; and examinations to be also made, of the best lines leading from the valley of its principal tributaries, to Gauley River, together with such other surveys and examinations as may be deemed necessary to ascertain the most advantageous route for the Railroad.

Resolved, That they also cause a survey to be made of the Kanawha River, from the Falls to Point Pleasant, together with an estimate of the cost of the proposed improvement.

Resolved, That in making the surveys and estimates authorized by the five preceding resolutions, such parties, not exceeding four in number, and such agents in addition to those now in the service of the Company, as they may deem requisite and proper, may be employed.

Resolved, That the President and Chief Engineer be instructed to communicate fully and regularly with the Consulting Engineer, upon the subjects of the proposed surveys and estimates; and that they report to the Board from time to time the measures adopted and the progress of the surveys.

Resolved, That they be authorized to have provided for the use of the parties to be employed in the surveys, such outfits of instruments, boats, baggage waggons, and other apparatus as may be necessary to their proper equipment for the duties to be performed.—*Va. Statesman.*

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### *Iron Steamboats.*

[The following letter from Col. Lamar, of Savannah, to Mr. Haynes, we take from the Pittsburgh Gazette. We have long desired information relative to these boats—the notice of the first arrival of which we published long ago. The fact that they are in use in this country has not been generally known until quite recently.]

*Savannah, March* 27, 1838.

***To the Hon. Chas. E, Haynes, M. C. Washington:***

Dear Sir,—Yours, of the 20th inst., enclosing certain queries of the Hon. Mr. Biddle, of the committee on Manufactures, on the subject of Iron Steamboats, was received to-day; and it affords me pleasure to give all the information I have obtained in regard to them, at all times; but more especially, when it is probable that it will so actively promote the use of them in our country. The one I imported is fully described in the annexed circulars.—[These are the documents heretofore published in the Gazette]—She cost $30,000 in 1834, exclusive of the duties which Congress remitted. Iron has since risen 50 per cent. in England, and there is great competition in that country for such boats, so that the cost is now 75 per cent. greater there than at that period. Nevertheless, two have been imported since for this river—two more are ordered for it, and two more for the Altamaha, besides those of Mr. Butts, on which a remission of the duties is now asked of Congress. I do not reply to the queries in order, because the circulars furnish all that is desired, except as to cost, and the expenses of completing them in this country, regarding which I shall particularise. The last boat imported was built at Liverpool, in 1837; cost there £2,900 including rivets, and materials for putting her up in this country. The freight will be about $800; and the completion, including deck and small cabin, about seven or eight thousand dollars; she weighs about 53 tons—is 115 feet long, 24 feet wide, and 8 feet hold—will draw, with a sixty horse engine, low pressure, boiler, and wood for 24 hours, (6 cords) not exceeding *thirty inches*, perhaps less. There is no necessity for bringing men to this country to put them up; any person who can strike a rivet can do the work. It is an improvement essential to the safety of life, as well as property, in the navigation of many of the rivers, but more particularly, the Mississippi. For, if provided with bulkheads, as those last imported are they could not be sunk in snagging; because, only one interval could be filled with water at the time, and if further improved by a like extension over the boilers, and connected with those partitions with large pipes or apertures for the escape of the steam over the sides of the boat, they would be protected, too, against explosions of the boilers, which are so frequent and so fatal on that river. Once on the Mississippi, at a moderate cost, my reputation is pledged that none other will be used if iron can be had. They are peculiarly adapted to that navigation, and *will defy its sawyers and explosions.* The duties will be about $2 80 per 100lbs. on the weight of them—a most onerous tax. I speak so freely because I am scarcely interested, at present, in any of those being imported. I sold mine at cost, and the purchasers would not take $50,000 for her now; and they think she will be good fifty years hence. Yours, &c.

G. B. Lamar.

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From the Papers of the Royal Engineers.

## *Notes on Concrete. By Lieutenant* Denison, *Royal Engineers.*

The very general employment of the mixture of lime and gravel, commonly known by the name of concrete, in all foundations where, from the nature of the soil, precautions against partial settlements appear necessary; and the great probability of an extension of its use, in situations where the materials of which it is composed are easily and cheaply procured, must of course render it a subject of great interest to the engineer.

The paper which conveys most information on this subject, is a prize essay by Mr. G. Godwin, published in the 'Transactions of the Institute of British Architects.' In this essay, many instances are brought forward of the employment by the ancients, of a mixture analogous to concrete, both for foundations and for walls. Several cases are also mentioned in which, of late years, it has been used advantageously for foundations, by some of the most distinguished architects and civil engineers. In these latter instances, the proportion of the ingredients vary from one of lime and two of gravel, to one of lime and twelve of gravel, the lime being in most cases Dorking lime, and the gravel Thames ballast.* The proportion, however, most commonly used now, in and about London, is one of lime to seven of ballast, though, from experiments made at the building of the Westminster new bridewell, it would appear that one of lime to eight of ballast made the most perfect concretion.

Concrete, compounded solely of lime and screened stones, will never assume a consistence at all equal to that of which sand forms a part. The north wing of Buckingham palace affords an instance of this. It was first erected on a mass of concrete composed of lime and stones, and when subsequent alterations made it necessary to take down the building, and remove the foundation, this was found not to have concreted into a mass.

Mr. Godwin states, as the result of several experiments, that two parts of stones, and one of sand, with sufficient lime, (dependant upon the quality of the material,) to make good mortar with the latter, formed the best concrete. As the quality of the concrete depends therefore on the goodness of the mortar composed of the lime and sand, and as this must vary with the quality of the lime, no fixed proportions can of course be laid down which will suit every case. The proportions must be determined by experiment, but in no case should the quantity of sand be less than double that of the lime. The best mode of compounding the concrete, is to thoroughly mix the lime, previously ground, with the ballast in a dry state; sufficient water being then thrown over it to effect a perfect mixture, it should be turned over at least twice with shovels, and then wheeled away instantly for use. In some cases, where a great quantity of concrete has to be used, it has been found advisable to employ a pug-mill to mix the ingredients: in every case it should be used hot.†

With regard to the quantity of water that should be employed in forming concrete, there is some difference of opinion: but as it is usually desirable that the mass should set as rapidly as possible, it is not advisable to use more water than is necessary to bring about a perfect mixture of the ingredients. A great change of bulk takes place in the ingredients of concrete when mixed together. A cubic yard of ballast, with the due proportion of lime and water, will not make a cubic yard of concrete. Mr. Godwin, from several experiments made from Thames ballast, concludes that the diminution is about one-fifth. To form a cubical yard therefore of concrete, the proportion of lime being one-eighth of the quantity of ballast, it requires about thirty cubic feet of ballast, and three and three quarters cubic feet of ground lime, with sufficient water to effect the admixture.

An expansion takes place in the concrete during the slaking of the lime, of which an important use has been made in the underpinning of walls,

* It is a question for consideration, whether a great variety of sizes in the materials used, would not form the most solid as well as the hardest wall. The walls of the fortress of Ciudad Rodrigo, in Spain, are of concrete. The marks of the boards, which retained the semifluid matter in their construction, are every where perfectly visible; and besides sand and gravel there are every where large quantities of round bolder stones in the wall, from four to six inches in diameter, procured from the ground around the city, which is every where covered with them.—*Lieutenant-Colonel Reid, Royal Engineers.*

† Mr. Godwin states, that the setting of ordinary lime results from the absorption of carbonic acid gas from the atmosphere. That the limes of mortars become sooner or later carbonates, is most certain, but there is no proof that this is the cause of their cohesion; indeed there is every reason to doubt it. It is more probable that new attractive properties are acquired at the moment that hydrates of lime are formed from calcined lime and water, when in close union with silex, alumina, and some other substances, and that the properties first acquired at that time, do not cease immediately, but continue, if undisturbed, for ages.—*Lieutenant Colonel Reid.*

The amount of this expansion has been found to amount to about three-eighths of an inch to every foot in height, and the size thus gained, the concrete never loses.

The examples from which the above rules are deduced, are principally of buildings erected in or about London; the lime used is chiefly from Dorking, and the ballast from the Thames. It is very desirable that a more extended collection of facts should be made, that the proportions of the materials, when other limes and gravels are used, should be stated, in order that some certain rules may be laid down by which the employment of concrete may be regulated under the various circumstances which continually present themselves in practice.

The Dorking and Halling limes are slightly hydraulic. Will common limes, such as chalk, and common stone-lime, answer for forming foundations of concrete, where the soil, although damp, is not exposed to running water? Is it possible, even with hydraulic lime, to form a mass of concrete in running water?* If common lime will not answer, may it not be made efficient by a slight mixture of cement? These, and questions similar to these, are of great interest, and facts which elucidate them will be valuable contributions to the stock of knowledge on this subject.

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## *Description of the Method adopted by Mr. Taylor, for Underpinning with Concrete, the Storehouses in Chatham Dock-yard. By Lieutenant* DENISON, *Royal Engineers.*

ONE of the large storehouses in Chatham dock-yard, having for some time exhibited serious defects in its walls, the attention of the Admiralty was directed to it in the year 1834, and Mr Taylor, the civil engineer and architect, was directed to report upon the best mode of obviating the evil.

Upon investigation, the foundation of the storehouse, (a building 540 feet in length, and fifty in breadth,) was found to be in a very bad state; the front wall, nearest the river, had originally been built upon piles, while the rear wall was laid upon an upper stratum of five or six inch plank supported by two rows of transverse and longitudinal oak sleepers lying on the surface of the ground, which in this case was of a variable consistence, containing flints bedded in a sort of clay, quite pervious to the water, which at high tide rose some height upon the foundation. The sleepers, and heads of the piles at the front of the building, thus exposed to alternate moisture and dryness, were in a state of rapid decay; in some places they were even reduced to a powder; and it was possible for a man to move under the walls in the space previously occupied by the timber: in the rear, the case was pretty much the same; the sleepers were

* As all *limes* are soluble, more or less, in fresh water, this seems very doubtful. Any attempt to check a spring, or stop the course of running water with fresh concrete, will certainly fail. An instance of this was seen at Chatham, where Mr. Ranger was constructing a dock with his patent concrete: in the floor of the dock were several springs, which, in spite of every attempt to check them with concrete, continually made their way to the surface, and in every case it was found that the lime had been washed away from the mass, leaving only the gravel and sand behind. Eventually it was found necessary to carry away the water in an iron pipe, and discharge it into the drain outside the dock. Mr. Godwin states, that the dock at Woolwich failed from using separate moulded masses of concrete, instead of employing it as one whole. In this case, had separate masses been used, and laid in cement, the work might have been carried on, though it might perhaps have failed eventually, from the solubility of the lime in fresh water affecting the blocks.---W. D.

universally in a state of decay, but in some places were much further advanced towards decomposition than in others.

The state of the storehouse requiring immediate attention, it was resolved to attempt to underpin the walls, and this, Mr. Ranger, the patentee for the new description of concrete, or artificial stone, undertook to do, he having adopted a plan proposed by Mr. Taylor, for forcing the soft concrete against the under part of the wall; and he proceeded to execute his contract in the following manner.

I must premise, that the storehouse was vaulted underneath, and that the piers, or cross walls, required underpinning as much as any other part of the building.

The walls were laid open to their bottom, both inside and outside the building; in the front, the heads of the piles and the sleepers were removed for a depth of about four feet below the bottom of the wall, and for lengths of about five feet at one time. In the rear, all the planks and sleepers were removed for the same distance. A mass of concrete, composed of one-eighth of Halling lime, (reduced to a powder by grinding, and in a perfectly caustic state,) and seven-eighths of Thames ballast, mixed up with so much boiling water as to reduce the whole to a pasty consistence, was then thrown from a height of about fifteen feet underneath the wall: it was allowed to project about a foot on each side, where it was confined by planks, and after being roughly levelled, it was well rammed, to give it as much consistence as possible. This mass was raised about three feet, or to within one foot of the bottom of the wall; it was then carefully levelled and covered with half-inch slates. A kind of framework was then placed on the slates, consisting of two cross-plates of iron, placed perpendicularly to the direction of the wall, about one foot wide, and long enough to project about one foot on each side of the wall. To these were fixed two frames parallel to the wall about four feet long, each carrying two sockets for screws. Within these frames were placed two moveable planks long enough to pass just free between the cross-plates, and wide enough to fit nearly the space between the slates and the bottom of the wall. Upon these planks were sockets for the heads of the two screws, by which the planks were pushed forward, or withdrawn at pleasure.

When the apparatus was fixed, and the moveable planks ready on both sides of the wall, about two barrows-full of concrete, mixed as above, were thrown in from above; the workmen below then commenced turning the screws on each side simultaneously, moving the two planks towards the centre of the wall, and forcing the concrete before them into all the vacant spaces, and against the bottom of the wall. When the plank was forced forward as far as it could go, by the force of two men to each screw, the concrete was allowed to rest for about five or ten minutes, by which time it had set hard enough to stand by itself, and its expansion in the act of setting completed what the pressure of the screws might have left undone. The planks were then withdrawn, another charge thrown in on each side, and compressed as before and this was continued till the whole space between the frames was filled with concrete. The screws were then removed, the boards and frames unbolted and taken out, and lastly, the side-plates were withdrawn, leaving an interval of about three-quarters of an inch between each mass of concrete, which space was afterwards filled in with grout.

The above description is given from notes taken at the time. Mr Taylor has since published an account of the same work in the Transactions of the Architectural Society, which does not differ materially from the above. The proportion of lime to gravel, he there states as one to six, and he brings forward more prominently the difficulties which were encountered, and the efficiency of the concrete in the mode in which it was applied. No settlement has taken place since the work was completed.

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From the London and Edinburgh Philosophical Magazine.

## *On a large and very sensible Thermoscopic Galvanometer. By* John Locke, *M. D., Professor of Chemistry in the Medical College of Ohio.*

*To Richard Taylor, Esq.*

Dear Sir,—The announcement of a new galvanometer will, perhaps, scarcely attract attention. But as I have been kindly encouraged by several eminent British philosophers to communicate some notice of my modification of the thermo-multiplier, I venture to send you the following sketch. Although a great labor has already been performed in electricity and magnetism, yet the adepts are aware that much remains to be executed, and that among the numerous principles already clearly established, it is probable that those proportions and arrangements which will produce the *maximum* effect have been in few instances fully ascertained. The chief novelty of the instrument which I am about to describe, consists in its proportions and the resultant effects. The object which I proposed in its invention was to construct a thermoscope so large that its indications might be conspicuously seen, on the lecture table, by a numerous assembly, and at the same time so delicate as to show extremely small changes of temperature. How far I have succeeded will in some measure appear by a very popular, though not the most interesting experiment which may be performed with it. By means of the warmth of the finger applied to a single pair of bismuth and copper disks, there is transmitted a sufficient quantity of electricity to keep an eleven-inch needle, weighing an ounce and a half, in a continued revolution, the connexions and reversals being properly made at every half turn.

The greater part of this effect is due to the *massiveness* of the coil, which is made of a copper fillet about fifty feet long, one-fourth of an inch wide, and one-eighth of an inch thick, weighing between four and five pounds This coil is not made in a pile at the diameter of the circle in which the needle is to revolve, but is spread out, the several turns lying side by side, and covering almost the whole of that circle above and below. The best idea may be formed of the coil by the manner in which it is actually modelled by the workman. It is wound closely and in parallel turns on a circular piece of board eleven and a half inches in diameter, and half an inch in thickness, covering the whole of it except two small opposite "segments" of about 90 degrees each. The board being extracted leaves a cavity of its own shape to be occupied by the needle.

The copper fillet is not covered by silk or otherwise coated for insulation, but the several turns of it are separated at their ends by veneers of wood just so far as to prevent contact throughout. In the spreading out and compression of the coil, it is similar to Melloni's elegant apparatus, though in my isolated situation in the interior of America, I was not acquainted with the structure adopted in his prior invention. In the *massiveness* of the coil my instrument is perhaps peculiar, and by this means it affords a free passage to currents of the most "feeble intensity," enabling them to deflect a very heavy needle. The coil is supported on a wooden ring furnished with brass feet and levelling screws, and surrounded by a brass hoop with a flat glass top or cover, in the centre of which is inserted a brass tube for the suspension of the needle by a cocoon filament. The needle is the double astatic one of Nobili, each part being about eleven inches long, one-fourth wide, and one-fortieth in thickness. The lower part plays within the coil and the upper one above it, and the thin white dial placed upon it, thus performing the office of a conspicuous index underneath the glass.*

I have not yet made any very extensive experiments with this instrument, being only just now prepared to do so. It is very sensible to a *single* pair of thermo-electric metals, to the action of which it seems peculiarly adapted ; but the efficieney of such metals is increased by a repetition of the pairs, as in the thermo-pile of M. Melloni, erpecially if they be massive in proportion to the coil itself. With a battery of five pairs of bismuth and antimony, the needle was sensibly moved by the radiation from a person at the distance of 12 feet, without a reflector, the air being at the temperature of 72°.

In a recent interview with M. Melloni, to whose politeness I am much indebted, he expressed his opinion that with a thermo-pile massive in proportion to the coil, my galvanometer might be made to exhibit his thermo-experiments advantageously to a large class. Some idea may be formed of its fitness for this purpose from the result of a single trial on "transmission." The heat from a small lamp with a reflector, at the distance of five feet, passed through a plate of alum, and falling on a battery or pile of five pairs of bismuth and antimony deflected the needle only a fraction of one degree, but on substituting a similar plate of common salt, the same heat produced, by impulse, an immediate deflection of 33 degrees.

Although the instrument is finely adapted by its size for the purpose for which it was intended, class illustration, yet from the weight of the needle and the difficulty of bringing it to rest after it once acquires motion, it is not so suitable for experiments of research as the Mellonian galvanometer. When a massive thermo-pile, such as has lately been made by Messrs. Watkins and Hill of Charing-cross, is connected with the coil and excited by a heat of about 200°, the needle being withdrawn, a distinct spark is obtained on interrupting the circuit; in producing this effect it is less efficient however than the ribboncoil of Professor Henry. The tube for suspension, placed over the centre of the instrument, is so constructed as to admit of being turned round by means of an index, which extends from it horizontally over the glass cover, and thus any degree of torsion may be given to the suspending filament or wire. A wire of any desired thickness may be easily substituted for the cocoon filament, when the instrument becomes adapted to measuring the deflecting forces of the galvanic battery. Ry using a thick wire it was ascertained that the calorimotor of Professor Hare having 40 plates, each 18 inches square, acted on the needle with a force equal to 92 grains, applied at the distance of 6 inches from the centre. In attempting to force the needle by torsion

* This instrument has been made by Messrs. Watkins and Hill, Opticians and Philosophical Instrument Makers, No. 5, Charing Cross.

into a line parallel to the coil, where the deflecting current acts with the greatest strength, I accidentally carried it too far and reversed its *position,* when instantly it became reversed in *polarity*, that which had been the north pole becoming the south. This showed how unfit is the magnetic needle to measure such a quantity of electricity as was then flowing through the massive conductor. The instrument is well adapted to show to a class the experiments upon radiant heat with Pictet's conjugate reflectors, in which the differential or air thermometer affords, to spectators at a distance, but an unsatisfactory indication. For this purpose the electrical element necessary is merely a disk of bismuth as large as a shilling, soldered to a corresponding one of copper, blackened, and erected in the focus of the reflector, while conductors pass from each disk to the poles of the galvanometer. With this arrangement the heat of a non-luminous ball at the distance of 12 feet will impel the needle nearly 180°, and if the connexions and reversals are properly made, will keep it in a continued revolution.

I have thus given you a brief sketch of an instrument which seems to supply a desideratum on the lecture-table, when the common thermometer is too small to afford to a class that direct and full satisfaction which, in a subject so important as that of heat, is very desirable to every professor. I have not, so far, attempted to use it extensively as an instrument of research, yet it shows evidently the importance of massiveness in conductors for feeble currents, such as those produced by thermo-combinations; nor am I certain that I have arrived at a maximum in this particular, for so far as I have proceeded in using thicker conductors for the coil, the deflecting effects have been increased. I am, &c.

London, Aug. 30, 1837. JOHN LOCKE.

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## *Report upon Dyeing Cloth with Prussian Blue. By* MESSRS. MERLE, MALARTIC, PONCET, and Co., *Saint Denis.*

THE process of dyeing woollen goods with Prussian blue has particularly attracted the notice of chemists for the last twenty years. The experiments which have been made in this science, by Messrs. Ramond, Sonchon, Chevreul, and by one of our colleagues, M. Dumas, have completely resolved the scientific question of fixing Prussian blue upon wool. Some of these experiments have been made upon so great a scale, as to leave no doubt as to the practicability of its general application. The question is then to know, if dyeing with Prussian blue can sustain a competition with indigo, as regards price, beauty, solidity, and duration. It would, doubtless, be a great service rendered to the country, to be able to use advantageously, an article that may be easily made in all places and in all weathers, instead of a substance which is an exotic, and of a high price. Such a result would be well worthy of the rewards of the society. According to the testimony of your president, M. C. Baron Thenard, and by that of many other gentlemen of celebrity and good faith, who have worn cloths dyed by the Prussian blue of Messrs. Merle, Malartic, Poncet, and Co., this dyeing process wears at least as well as indigo; and the seams and other parts of the clothes that are exposed to continual friction do not become white, although the cloth is dyed in the piece. According to the report of the beauty of the color, the specimens sent leave nothing to be desired. The reflection of the color gives a vivacity and purity of tone which is never met with in indigo dyes, particularly in the clear shade. The chemical experiments that have been made with these specimens, have proved that the dye has really Prussian blue for its base, that it contained no indigo. that it was decomposable by caustic alkalies, but that it resisted very well the action of acids and of chlorine. Your commissioners, who have visited the establishment of Messrs. Merle, Malartic, Poncet, and Co., at St. Denis, have found it arranged for working upon a large scale. They have there seen pieces of cloth in the course of manufacture, and others entirely finished. These pieces appeared to them to be of a very fine color, perfectly dyed, and the quality of the wool well kept. They have also been able to acquire proofs (by the register and correspondence that has been given to them) that this establishment works for commerce, and that business is carried on with many important houses in the cloth trade. In this state of things, the committee would have wished to be able to propose a reward of the first order, for Messrs. Merle, Malartic, Poncet ond Co.; but these gentlemen wishing to keep for some time longer the secret of their application of dyeing, and the statutes of the society not allowing any reward to be granted, except to a perfect and complete communication of the whole process your committee feel bound to make honorable mention of them, in order to reserve to them all their rights for a more important reward, when they shall deem it expedient to make their process known.—*Signea, Bussey Reporter, Bulletin de la Societé d'Encouragement.*

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*Siliceous and Calcareous products obtained by means of slow actions; Report by* MM. Gay-Lussac *and* Becquerel, *on a note of* M. Cagniard-Latour.

M. Cagniard-Latour states that by the means of several processes which he has devised, and which are dependent upon slow action, he has succeeded in forming various substances analogous to those which are found in nature. The following are some of the results which he has obtained.

" *First Experiment.*—Some lamp-black was treated with hot concentrated nitric acid; the liquor after having been poured off was exposed under a bell-glass for several months to the action of solar light; in proportion as the acid diminished, water or acid was added; by degrees siliceous concretions formed, some of which inclined to the pyramidal form. Analysis indicated two per cent of carbon; these concretions submitted in a platina crucible to the action of caustic potash, heated by the flame of an alcohol-lamp, diminished in size; their hardness is sufficient to scratch rock crystal.

" *Second Experiment.*—Some of the bog iron *(fer limoneaux)* of Berry was taken; after having reduced it to a very fine powder, was treated with hydrochloric acid; the solution was diluted with water and was filtered; it was next put into a large retort, and a glass capsule containing a piece of white marble was then suspended in it. The marble was gradually attacked, carbonic acid gas was disengaged; oxide of iron was deposited, and crystals several millimetres in length having the form and principal properties of felspar with a calcareous base.

"*Third Experiment.*—Milk of lime *(lait de chaux)* was poured into a solution of perchloride of iron, to which had been added a brown infusion of roasted corn. The precipitate having been well washed in water, then mixed with this liquid, the mixture was heated in a kind of Papin's digester until the interior pressure amounted to eleven atmospheres; siliceous grains were precipitated produced from the milk of lime. The matter was then taken and re-dissolved anew in hydrochloric acid; the solution having been filtered, it was again filtered through chalk of Meudon, which had been passed through very fine cambric, by means of water, to separate the grains of quartz from it. Oxide of iron was deposited in the chalk. When the filtration was difficult, the liquor was acidulated. At the end of fifteen days the Meudon whitening was again strained through the cambric, and the part which had not passed was treated with hydrochloric acid; small opalascent siliceous concretions were obtained, of which several have the form of crowns and are split from the centre to the circumference; they are not fusible with the blowpipe and scratch glass; those which were colored being moderately heated, acquired a smoky tint in consequence of the organic matter which they contain.

"*Fourth Experiment.*—125 grammes of powdered Meudon whitening were put into a glass tube about two inches in diameter, and four feet and a half in height; the lower part of the tube was then closed with a piece of linen rag intended to serve as a filter. Afterwards water was put into the tube, and the whitening was shaken so as to mix it well. After having completely filled up the tube with this water, some water very weakly acidulated with hydrochloric acid was prepared; and in proportion as the water first put into the tube filtered away through the whitening and the linen upon which it rested, acidulated water was poured into the tube. The filtered water deposited by degrees in a bottle in which it was received, crystalline grains of carbonate of lime; and at the same time the linen serving as a filter, became covered over a great part of its exterior surface with a crust which, examined with a magnifying glass, had the appearance of saccharoidal marble. The experiment lasted about three months. The quantity of whitening of Meudon which was dissolved during the time that the filtration continued was about 75 grammes, that is to say, a little more than the half of all the whitening which had at first been put into the tube."—*Comptes Rendus*, No. 25, June 1837.

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## *New Carburets of Hydrogen, Rétinnapthe, Rétingle, Rétinole, and Métanapthtalene.*

MM. Pelletier and Walter have examined the products obtained during the conversion of resin into gas for gas lights; the results are stated to be:

1st. The instant the resin falls into the red-hot cylinder there are formed with the gas a certain number of extremely hydrogenated compounds which have been separated by chemical analysis.

2nd. Among these substances there occur three new carburets of hydrogen, to which the author has given the names of *rétinnapthe*, *rétingle*, and *rétinole;* these are all liquid: there are two solid carburets of hydrogen, *naphtalene*, already known, and *métanaphtalene*, a new compound.

3rd. Rétinnapthe is a very light and volatile fluid; its composition determined by the density of its vapor, may be represented by $C^{28}H^{16}$. This product, M. Pelletier observes, is at least isomeric with one carburetted hydrogen, which is still hypothetical, but which appears to play a great part in the benzoic compounds, if indeed it be not itself this carburetted hydrogen; it gives rise to a series of new compounds.

4th. Rétingle is a new sesquicarburet of Hydrogen, which may be represented by the formula $C^{36}$, $H^{34}$, $H^{24}$ [?]; it is susceptible of conversion by the action of chlorine, bromine, and nitric acid, into compounds which exhibit a series of new combinations.

5th Rétinole is a new bicarburet of hydrogen, the formula of which is $C^{64}H^{32}$; it differs from the bicarburetted hydrogen of Faraday $C^{24}H^{12}$, both in its constitution and its chemical properties.

6th. Métanaphtalene is a new substance, which differs from naphtalene in its properties, but isomeric with its composition. It is remarkable for its splendor and beauty, its chemical indifference, in which property it resembles paraffine, from which it differs totally in its properties and composition.

The substances whose properties and composition have now been briefly stated, result from the sudden application of a red heat to resin. M. Pelletier states, that in a second memoir he will examine the properties of the products obtained from resin at lower temperatures.—*L'Institut*, June, 1837.

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From the London Journal.

## *Report of Transactions of the Institution of Civil Engineers.*

### Session 1837.—January 10.

James Walker, Esq., F.R.S., L. and E., President, in the Chair.

The President, having called the attention of the meeting to the conversation on cements which had taken place when they last met, requested Col. Pasley, who had made many extensive experiments on this subject, to give the meeting some account of the results at which he had arrived.

Col. Pasley said, that his attention had been directed to the subject of cements from reading in Smeaton's works that all water limes were composed of carbonic acid clay; since, on dissolving these limes in carbonic acid, clay, of which brick could be made, was left. From this remark he had been led to make experiments similar to the following: he took *two* parts of chalk and *one* of clay. The chalk being pounded and mixed with the clay, balls were formed, which being burnt in a crucible, were ground and mixed as cements usually are. Some of these experiments failed, but he attributed their failure to his having used clay which was coarse and sandy; whence it appears that substances will unite when in the form of a fine powder which will not unite when in a coarser form. These experiments were made in the years 1829, 30, 31, and 32. Subsequently, in 1836, he repeated his more successful experiments, but without the same success; and he attributed their failure to the fact of the clay (the blue clay of the Medway) containing a greater proportion of carbonate of lime than it had contained five or six years before.

Continuing his experiments, he found that *four* lbs. of dry chalk and *five* pounds of the moist blue clay, fresh from the Medway, made the strongest cement, but he had determined many other proportions which set immediately under water. With cement made according to the above proportions, thirty-one bricks had been set out from a wall, one brick being added every day, omitting the Sundays.

He had cemented bricks together, and he found in every case that the bricks gave way and not the cement. He estimated the breaking force at the joints at about 5000 lbs. on the thirty-six square inches, the surface of the brick. On comparing the strength of this cement with the chalk mortar which had united some bricks more than thirty years, he was led to consider the adhesive power of his artificial cement forty days' old as at least twenty times the power of the mortar.

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January 31, 1837.

W. Cubitt, Esq., V. P., in the Chair.

"Description and Drawing of an Apparatus designed by Mr. Mitchell for Boring Wells; by Mr. Mitchell, Jun., of Sheerness."

This apparatus consists of a frame, similar to that of a pile engine in which the rods are suspended; on one of the rods is a wheel fixed on a square spindle (through which the rod can slide), and turned by means of a pinion and crank; the axis of this pinion serves also to draw the rods, since they may be drawn up by a single rope, or by a tackle suspended to the top of the frame, the rope of the block passing round the winch. The auger is regulated in the cut by a screw and nut; thus the rods are always kept from bending in the hole, and the bore from getting out of the perpendicular. This apparatus is found peculiarly convenient in chalk, and when stones are met with; since in most cases, if the auger be sufficiently hard, the stones flash off in small chips similar to gun flints.

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"A Method of breaking Ice by forcing it upwards instead of downwards; practised on the Herefordshire and Gloucestershire Canal in the Winters of 1834-35 and 1835-36; by Stephen Ballard, A. Inst. C.E."

Mr. B. places strong planks covered on their upper side with sheet iron in the front of a boat, so as to form an inclined plane pointing downwards; the lower end of which goes under the ice. The boat, drawn by a horse, is steered by a person walking on the shore with a long shaft attached to a pole projecting over the stern. It is believed that one boat, horse, and boy, would thus break much more ice than three boats worked in the usual manner.

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Mr. H. H. Price called the attention of the Institution to the importance of ascertaining what are really the constituent elements of Artificial Hydraulic Mortars and Cements; several memoirs have been read before the Institute of France on this subject, but they exhibit great discrepancies as to the principles of the formation of these cements. It is of the greatest importance to the engineer to know from the materials at hand how to make a cheap average hydraulic mortar.

Col. Pasley remarked, that he considered Smeaton's Researches as the only ones of value; the French philosophers had followed out many of his suggestions in great detail. Two systems appear to have been pursued in France, the one in which the substances are burnt previously to their being mixed, the other in which they are mixed in a state of minute division previous to their being burnt. The Aberthaw limestone used by Smeaton consisted of carbonate of lime and clay; *one* part of the lime from this stone and *two* parts of sand make a cement which sets very hard in time, but the joints must be protected at first by Sheppey or some similar cement.

Mr. Lowe was of opinion that very much must be attributed to the presence of silica; this evidently played a most important part. Limes have exceedingly different qualities; two makers using the same quarry would produce very different limes; if lime is flare-burnt, that is, burnt at a white heat, all the carbonic acid is driven off suddenly; the properties of lime burnt at a slow heat will differ much from the properties of the preceding. The mechanical mixing is also of the greatest importance; the Barrow lime is a natural hydraulic lime, but it must be well beaten with water and silica or sand.

Mr. Blunt, from America, gave, at the request of the Chairman, an account of the system of signals which were employed in the geometrical operations now carrying on in America.

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February 7, 1837.

The President in the Chair.

The conversation on artificial cements being resumed, several members expressed their opinions on the causes to which the hardening of mortar was to be referred. Hydrate of lime is the basis of all mortars, but this will not make a water mortar, or cement, without the addition of a metallic oxide. The addition of clay will effect this, but most clays contain a metallic oxide.

Mr Francis Bramah gave the analysis of Dutch Terras, of Basalts, and of Puzzolana, according to different experimenters; in all these there is a considerable proportion of iron; and the addition of any of these to hydrate of lime will make a water mortar. Thus it appears that we must carefully distinguish between a good mortar, and a good water mortar or cement. Hydrate of lime is the basis of both. Good mortar depends for its excellence on the slow absorption of carbonic acid, and the slow absorption of this is, according to Tennant, the essential condition for good mortar. It is remarkable that, according to Pliny and Vitruvius, the Romans kept their mortar for three years, and it is now the custom among builders to bury mortar, or to keep it in a cellar; it is thus prevented from absorbing carbonic acid from the atmosphere, or, in other words, from being reconverted into limestone. According to some experiments of Tennant, it appears that mortar in $3\frac{1}{4}$ years will regain 63 per cent. of the carbonic acid of which it had been deprived. The absorption of carbonic acid being the condition of mortar hardening, if it be used under circumstances such that this absorption cannot take place, as under water, some other material must be supplied, and the addition of a metallic oxide appears to supply the required element.

With respect to an hypothesis of Kirwan's which had been mentioned, as to the peculiar properties of iron and clay, Mr. J. I. Hawkins stated a singular fact which had come under his own observation, namely, that the rust of iron has a peculiar disposition to travel through moist clay; the rate of this transfer was in one case about *one* inch per month.

"On Locomotive Engines, and the means of supplying them. By Jacob Perkins, M. Inst. C. E."

The object of this paper is to show how locomotives may be supplied. The practical defects of the present system of locomotives arising from the furring up or bruising out of the tubes of the boilers, Mr. Perkins proposes that steam should be generated through the medium of surcharged steam. He states, that if a tube hermetically sealed be filled to $\frac{1}{60}$th of its contents with water, the steam arising from the water will not acquire sufficient elastic force to burst the tube, but will have a remarkable property of transferring heat. The steam being saturated with heat, requires no more, and the tube being vertical, this surcharged steam becomes a floating agent, through which the heat ascends its own levity, so that the *top* of the tube would become red hot, were it not immersed in water. The difference between pure and surcharged steam is, that surcharged steam gives up its heat without condensing it. whereas pure steam must necessarily condense as it parts with its heat. Mr Perkins states, that a boiler has generated steam on this principle under the action of a fervent heat during the last seven months, and without the least leakage or incrustation.

Mr. Perkins then details the advantages which may be gained from the adoption of his principles, and proceeds to make some remarks on the manufacture of locomotives. He recommends the division of labor, that the engines should all be fac-similes, and each part be manufactured at the places best adapted for their production. The paper concludes with observations on the most effective application of steam: on the best velocity of the piston, and relative proportions for the diameter and length of the cylinder.

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Mr. Blunt, at the request of the President, then stated some facts respecting the American steamers. The double boats had been given up, and the average speed of the best boats was fifteen miles per hour. One boat, whose length is 220 feet, and breadth eighteen feet, has an average speed more than the preceding. They had recently introduced a ferry boat, which might, he conceived, be extremely serviceable in our rivers; in the Thames for instance, where there are a great number of vessels. The boat had bows at each end, so that it could go either way, and rudders at each end worked by one helm; the boat is thus steered at both ends. The rudders are placed in a semicircular chamber at each end, and can be reversed round; they are worked by a chain passing round the wheel of both and crossing in the middle, so that the boat is brought about in the same direction by the contrary action of the two bows. The wheel and chain cannot get out of order, and the rudder begins below the water, so that the boat can go through the broken ice. Such a ferry boat will go round without going her length, which is about one hundred feet.

Mr. Blunt had repeatedly gone a distance which he knew, from actual trigonometrical measurement, to be seventy-four miles in five hours. The boats completed the distance from New-York to Albany, not less than one hundred and fifty miles, in ten hours. The speed of these boats, as compared with that of the boats in this country, is not to be wondered at, when it is remembered that the boats are built simply and expressly for speed. The Americans pay great attention to the form of their boats: the water is smooth, the engines are placed on the deck and the boilers on the wings; and they spare no expenditure of power provided speed can be obtained.

February 14, 1837.

The President in the Chair.

"Description of Mr. Henry Guy's method of giving a true spherical figure to balls of metal, glass, agate, or other hard substance." Communicated by Bryan Donkin, Esq., V. P. Inst. C. E.

The method adopted by Mr. Guy, consists simply in applying to practice the principle, that if a ball can be made to revolve rapidly in every possible direction, or in other words, if during such revolution its axis of rotation be constantly changing its angular position within the ball itself, whilst a grinding tool is applied to the surface of the ball, the most prominent parts of that surface will be first acted on by the grinder, and by continuing the operation the whole of the higher parts of the surface will be progressively ground off, and the ball will ultimately be left of a perfect spherical shape. Mr. Guy effects this by placing the ball betwixt the faces of two wooden chucks fixed to two lathe mandrels, such as are used in common turning lathes, with their axes exactly in a line with each other. A quick motion is given to the mandrels in the usual way by two bands, so applied that the mandrels are placed in opposite directions; the ball being compressed betwixt the chucks turns, notwithstanding the friction of the tool. The tool is a bar of brass or iron, with a conical hole near one end, the larger diameter of which is made a little larger than the diameter of the ball.

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"On the Construction of Railways of continuous bearing, by John Reynolds, A. Inst. C. E."

The author states the conditions essential for a good railway to be as follows: 1st. That it should be the closest practical approximation to a perfect plane of perfect stability. 2nd. That it should be adapted to prevent or to neutralise the vibrations from the impact of imperfect cylinders rolling on imperfect planes. 3rd. That it should possess the greatest durability and the greatest facility of being repaired which are compatible with the above conditions. Mr. Reynolds proposes trough-shaped cast iron bearers, having rectangular bearing surfaces, the angular point being downwards. Thus a section of the bearing part of the rail across its length is a right angle, with its vertex downwards. By this peculiar shape the sustaining area is increased, a greater resistance to vertical pressure is consequently obtained, and the lateral stability of the rail is secured. The rails are to be laid in earth, ashes, or broken stone and gravel, and the sustaining surface of the earth may have any requisite density communicated to it by rolling or beating the earth at the sides, so as to give it sufficient density to resist the pressure to which the rail is to be subjected. The mass being composed of materials which will not readily yield or slip away, will be incapable of further condensation by any subsequent pressure not exceeding that to which it had been originally subjected by the beaters or rollers acting at the sides.

The rails which Mr. Reynolds uses are of two kinds; rails wholly of cast iron, cast in one piece, and rails either of wrought or cast iron laid on a sill of wood, the wood being placed in a cast iron bearer of the shape already described. The rails, sills, and bearers in this latter construction, break joint with each other, and are held together by bolts passing through all three. Thus one continuous structure is formed throughout the whole line, and the fracture of the three parts in the same place is highly improbable. The vibrations will be neutralised by the sill of wood acting as a partially elastic cushion in receiving the concussion to which the rails are subjected ; and this latter mode of construction is considered preferable as admitting of the use of either cast or wrought iron rails.

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February 21, 1837.

Bryan Donkin, Esq., V. P., in the Chair.

The construction of railways on the principle of continuous bearing, as adopted by Mr. Reynolds, and described in his paper read at the last meeting, was discussed. Some of the rails and bearers cast in a single piece, having been laid on Chatmoss, inquiries were made as to how they had answered. It was stated that they were kept in order at less trouble than the others, and that they showed no tendency to sink. It was intended to use the commonest timber for the sills ; the wood having been boiled in tar, and allowed to cool in the tar, becomes so saturated with tar that it will not imbibe moisture.

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"A Steam Expansion Table, by George Edwards, M. Inst. C. E."

In the paper explanatory of this table, the author remarks, that it has become a matter of interesting inquiry, why the expansive property of steam is as yet so little used, when attention has been directed so much to the economising fuel by improved boilers, and other similar means ; and the more so as patents were taken out by Hornblower in 1781, by Watt in 1782, and by Woolf in 1804, for working steam expansively. The objections to the use of high pressure steam may perhaps be an obstacle ; but there are many cases, as in the engines of tug boats, to which these objections cannot apply.

Very incorrect notions having existed of the expansive properties of steam, the author has, according to the admitted law, "that (the temperature being constant) the bulk is inversely as the pressure," constructed a table, showing at one view the resulting pressure on the expansion of a given volume of steam of given density, and *vice versa.*

Mr. Edwards then describes the construction and method of using the table, so as to answer at once questions similar to the following :—"Required, the pressure of 50lb. steam when expanded three times its volume." "In a high pressure engine, working expansively, required the length of the stroke at which to cut off the steam, that the pressure may be 14lb. at the end of the stroke." "In a Woolf's engine, working 54lb. steam, required the capacity of the larger cylinder, the smaller being unity, so that the pressure of the steam shall be 4lbs. on the completion of the stroke of the large piston," &c. &c.

With respect to the principle on which this table is calculated, it was stated that the temperature does not remain constant, and that the pressure falls off most rapidly on the steam being cut off, and reference was made to some experiments made by Mr. John Taylor on this subject.

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February 28, 1837.

The President in the Chair.

"On a peculiar form of Rail, and the construction of Railways in America and Germany, by Herman Koehler, of Leipzig, M. Inst.C.E."

The pattern, which the author describes, is by American engineers called the inverted T rail (⊥), and was introduced in order to avoid trouble and expense, which railways are liable to where the rails are placed in chairs and fastened with keys. The material used for this need not be of first quality, but in cases where it is expedient to support a general confidence in the quality of the iron, good and sound rails can be made of $\frac{2}{5}$ths of No. 2, Welsh iron, and $\frac{3}{5}$ths of No. 3, employing the better quality for the head and bottom, and No. 2 for the stem of the rail, rolled in such manner that the lamina of the iron lie horizontally throughout.

The experience of all railways seems to confirm the opinion that chairs and keys to keep the rails firm to their places are a great and expensive inconvenience, and a dangerous construction whether wood or iron be the material of the keys. The author then details the advantages of the rail, especially if laid on a continuous line of stone or wooden sleepers at a small distance apart.

Wooden railways are at this time used in Germany, and the author has laid 9 miles between Leipzig and Dresden. Wooden sleepers, 8 inches square, are placed upon trenches cut across the embankment at every yard, and filled up with a bed of broken stones, one foot deep. Notches $3\frac{1}{2}$ inches deep are cut into these cross ties to receive the wooden rails of 6 by 9 inches, which are shod with iron plates of one inch thickness and $2\frac{1}{2}$ inches width. At their joints they put together on iron-plates $\frac{1}{8}$th of an inch thick to prevent their being pressed into the wood. The rails are wedged firmly to the sleepers by wooden wedges. The head of the spikes with which the iron rails are fastened to the wood are of a conical form, and fit into corresponding holes, these having an elliptical form to prevent the spike from being drawn or bent on the contraction and expansion of the iron rail. The ends of every iron plate rail are fastened with screw bolts, passing through the whole height of the wooden rails, firmly to their places, which is a very important precaution, as the engines are apt to catch the points of the plate rails with their wheel flanches, and to run off.

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"A drawing and description of a new Lewis, by Henry Robertson, Glasgow." Communicated by the Author.

The proposed Lewis consists of two pieces of iron, whereof each is a bent lever, connecting at a joint by a strong bolt. When the upper or longer arms are drawn together by the power, the under or shorter arms inserted into the hole are forced against the sides, and by properly increasing the proportion of the upper to the under arm, any necessary power may be given to the instrument.

The advantage of this Lewis, as compared with the one of three pieces in general use are, that it can be inserted into and removed from the hole in far less time; it adapts itself to the form of the hole, all fitting and plugging with slips of iron being unnecessary, and exerting its pressure directly against the sides of the hole, is less apt to chip off the edges and endanger the falling of the stone.

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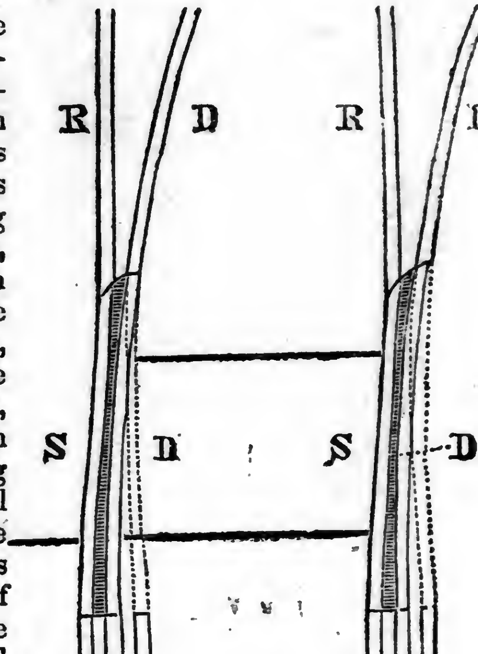
"Experiments on the Strength of various kinds of American Woods exposed to a Transverse strain; by Lieut. Denison, of the Royal Engineers, A. Inst. C. E."

These experiments were undertaken with the view of establishing, first, some common standard of comparison between the woods in general use in that country and in our own; and, secondly, to ascertain the change in strength caused by seasoning. The latter series of experiments, unfortunately, was not made.

[We copy from the Civil Engineer and Architect's Journal, a London periodical, for March, a description, with an engraving, of "*Curtis's Improved Railroad Switch.*"]

### *Curtis's Railway Switches.*




The annexed figure shows the Switches so arranged, that an engine can never run off the line, under any conditions of the switch being placed wrong; this object is effected by forming the switches double on both sides, and laying down supplementary rails, *r d*, *r s*, which correspond respectively with the diagonal and straight bars of the switch. Referring to the engraving, if an engine be coming along the line *r*, in the direction of the arrow, it will pass over the diagonal switch and cross the line; if coming along the line in the reverse way, it will pass over the straight bar of the switch and enter the line by means of the supplementary bars, *r s;* if the switch be made to occupy the space shown by the dotted line, and an engine is coming along the line in the direction of the arrow, it will pass straight along the line, and if coming the reverse way along the diagonal line, it will pass along the diagonal switch *d*, and enter the line by the supplementary bars *r d*.

The improved switches represented in page 52, in the last Number, have been at work upon the London and Greenwich Railway for more than twelve months; they have never been out of repair, nor failed in a single instance. The London and Birmingham Railway Company are now laying them down at the various stations upon the line.

*1, Stafford-street, Bond-street.* W. J. Curtis.

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### *Power of Traction of Locomotive Engines.*

*To E. F. Johnson, Esq., Civil Engineer:*

Dear Sir—In your recent letter to the President and Directors of the New-York and Erie Railroad Company, you have given a table exhibiting the power of traction of Locomotive Engines, at different rates of speed, and various inclinations of the road—deduced from the formulæ of De Pambour.

I do not doubt the accuracy of the computation of this table. But the formulæ, however, from which it was deduced is erroneous, giving results easily demonstrated to be false, and plainly contradicted by experience, as I hope to show you below.

On the 16th of August, 1834, De Pambour made an experiment on the Liverpool and Manchester Railway with the engine Vesta, (the dimensions of which are carefully given by him) which resulted as follows:—The engine drew a load including the tender, equal to 189 tons on a level road, at a speed of three miles per hour. According to the formulæ, the engine ought to have drawn 1061 tons at this speed; thus showing a discrepancy in this instance between the results of the formulæ, and experience of 872 tons; or, in other words, the formulæ gives more than five and a half times as much as the engine can draw at this speed.

This is by no means an insulated case in De Pambour's experiments. It is the greatest discrepancy that exists, and taken on this account, because it exhibits the error more perspicuously; at the same time there is a great difference, in almost every instance, between the experiments and the results of the formulæ.

It would be easy to show wherein the formulæ is wrong—this, however, I design to do in another form hereafter. My present object is to call your attention to a re-examination of the table.

In this table the load for the 13 ton engine on a level road, is 584 tons, at a speed of $7\frac{1}{2}$ miles per hour. If in general we make

M = the load, including the tender, in tons.
$n$ = the friction per ton, of the load, plus additional friction per ton upon engine.
F = the friction of the engine without load.
D = the diameter of the driving wheels.
$d$ = the diameter of the cylinders,
$l$ = the length of the stroke,
and $p$ = the atmospheric pressure per unit of surface;

then $(F+n\,M)\dfrac{D}{d^2 l}+p$ will be the resistance which the load opposes to the motion of the piston.

By substituting the appropriate figures, according to the dimensions of the engine, in place of the letters which represent them in the above formulæ, and expressing the same in units similar to those used for the total pressure of steam in the boiler, the result will be:—

$$[182+(8\times 584)]\times\frac{54}{(14)^2\times 16}+15=98{\cdot}58 \text{ lbs. per unit of surface, or}$$

square inch. And this is the resistance opposed to the motion of the piston according to the above formulæ.

You will observe that the total pressure of steam in the boiler, and *a priori* on the pistons, is 70lbs. per square inch. It is plain, that this pressure cannot move them while loaded with a resistance of 98·58lbs. per square inch.

I would here remark that the above formulæ is not precisely correct, inasmuch as no allowance is made for the imperfect application of the engine's power through the crank motion. The error, however, is small, and would, if taken into the computation, show a still greater resistance, But this formulæ, it is to be believed, abundantly demonstrates the inaccuracy of the table, and is one which probably is familiar to most engineers, certainly to all who have read De Pambour's treatise on Locomotive Engines—for this reason it has been used in this examination.

De Pambour has given a formulæ for determining the maximum load that an engine can move, which is as follows:—$M \times \frac{(P-p) \times d^2 \times l}{n \times D} - \frac{F}{n}$, where P represents the total pressure of steam in the boiler, and the remaining letters the same as above. This formulæ is also incorrect, for, as may easily be seen, all the elements of the preceding one enter into this, and of course bring with them the errors they there contained.

By substituting figures in the place of the letters which represent them in this formulæ, we have for the maximum load which the 13 ton engine is able to move, $M = \frac{(70-15) \times (14)^2 \times 16}{8 \times 54} - \frac{182}{8} = 376$ tons; and 276 tons for the engine weighing 10 tons: or, in other words, the load given in the table for the engine at 7½ miles per hour, is, according to this formulæ, in one case 55, and in the other 62 per cent. greater than it can move.

These remarks sufficiently illustrate the inaccuracy of the table in these instances. The error being in the formulæ by which it was computed, must of course run through the whole table, although less in degree, as the velocity approximates towards the velocity at which De Pambour's experiments were made.

I have used much frankness in the foregoing communication, under a conviction of the great importance of disseminating nothing but correct information on this subject, and a belief that this alone was your object in the letter referred to—and also, that the confidence placed in De Pambour by Engineers generally, has induced you to make use of his formulæ in this instance, without thoroughly investigating the elements of which it is composed. With much respect and esteem, I am, dear Sir,

Yours, &c.

Wm. H. Talcott.

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*Messrs. Minor & Schaeffer:*

Gentlemen—Since the publication in your Journal* of a recent letter of mine to the President and Directors of the New-York and Erie Railroad Company, in which I gave a tabular statement of the power of traction of Locomotive Engines, under different velocities, computed from De Pambour's formulæ, I have received the annexed communication from W. H. Tallcott, Esq., Civil Engineer, directing my attention to an error in the table, which at the time of making the computations, owing to the haste in which they were performed, was not noticed.

In estimating the range of power of a locomotive engine, at different velocities, and under a given pressure of steam in the boiler, it is obvious that nothing can be gained in power by reducing the velocity below that point where the pressure of steam upon the square inch in the cylinder is equal, or *nearly* equal, to the pressure in the boiler.

The formulæ of De Pambour gives under a continued decrease of velocity a continued increase of power, and does not therefore designate the point at which it ceases to be applicable.

This formulæ, although presenting results which perhaps do not vary

* See No. 49, Vol. VI.

greatly from the truth for those velocities at which the experiments were made under the higher pressures, or those ordinarily used, differs more and more widely from the actual results in proportion as there is a greater departure from those velocities, and those pressures.

In computing the table referred to, it did not occur at the moment, that the minimum velocity assumed being 7½ miles per hour, (which was certainly not a *very low* rate of motion) would give results differing as much from the truth, as appears by Mr. Talcott's communication. I was fully aware, from the character of the formulæ, that there would be a variation, but owing, as stated above, to the too great haste in which the table, &c. was prepared, I omitted to test, as I might easily have done, the accuracy of the calculations.

I trust there are none who know me who would believe that I would designedly attempt to mislead, or that I am so obtuse on so plain a proposition in mechanics, as deliberately to assert that a locomotive engine is capable of overcoming a resistance, which when referred to its'action on the piston, is *greater* than the opposing force of the steam upon the same pistons.

By referring to the table given in my letter, it will be evident that there is little or nothing gained in power, by reducing the motion down to either of the two lowest rates of velocity there mentioned, since it appears that before reaching those points, the pressure of the steam in the cylinder, must be at its maximum, or nearly so, or otherwise it could not overcome the resistance offered by the load,which the formulæ exhibits as practicable above those rates.

My principal object in presenting the subject in the manner in which I did, was to illustrate some of the general principles involved in the operation of the Locomotive Steam Engine, showing that it possessed a range of power which would enable it, to a certain extent, to accommodate itself to variations in the grade line, simply by a change in the velocity.

As to the accuracy of De Pambour's formulæ within those limits in which it may be consideredproperly applicable, although I believed it to be nearer the truth than it appears on a more critical examination, yet, I gave it as my opinion that it was imperfect, inasmuch as there were defects "both in the mode of conducting and analyzing his experiments." Not possessing the means of measuring the extent of those defects, and knowing that they would not materially affect the object in view, I preferred giving the results in strict conformity with the formulæ. This course was preferred also that the public, as well as the profession, might understand precisely the ground on which they were obtained.

It may, I think, be questioned,if the full pressure or force of the steam in the boiler was correctly ascertained by any of De Pambour's experiments, whether derived upon the spring balance as corrected, or the mercurial gauge. Whatever difference there might have been in this respect, if any, would serve rather to increase the range of power under the assumed pressure, placing somewhat lower in the scale the greatest velocity corresponding to the maximum load.

The subject of the principles of operation and mode of construction of Locomotive Engines, is one of great importance. De Pambour has done much, very much, towards adding to the stock of knowledge on this subject. His experiments are valuable, but they require to be extended and carefully revised.

I understand from Mr. Talcott, that should he succeed in obtaining additional facts, with which he hopes to possess himself the coming season, he feels confident that he will be able to present a formulæ which will give results approaching very near the truth for all practicable velocities and degrees of pressure of the steam, &c. The attention he has given to the subject, and his practical knowledge of the management of Engines, will, I doubt not, enable him, with the aid of the experiments and labors of De Pambour, to accomplish more than has yet been effected by those who have heretofore written on the subject.

By giving these remarks, together with Mr. Talcott's communication, an early insertion in your valuable Journal, you will much oblige,

Yours, truly, E. F. JOHNSON.

*Albany, April* 7, 1838.

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## *Steamboat Dispatch—Bennet's Boiler.*

We have again had the pleasure of making an excursion in the Steam-boat Dispatch, built by Capt. Cobb, for the purpose of testing Mr. Bennet's new and striking invention, so frequently alluded to in our columns. The boat has only quite recently been finished, and the proprietors and inventors desirous of giving an opportunity of testing the economy and safety of their machinery, appointed the 13th of June for an experimental trip, to which the members of the American Institute, and several other gentlemen, were invited

The day selected proved a most auspicious one, and the trip to Sandy Hook and back, a charming sail, affording an agreeable relief from the extreme heat then prevailing in the city.

At half past ten o'clock, the boat left the Battery—as soon as the blowing apparatus was connected, the alternate puffs of steam, smoke, or whatever else it may be called, rolled forth in miniature clouds, and presently in rapid succession. The boat very soon obtained a good headway, and proceeded down the Bay against a strong tide, with much ease. The motion was by no means unpleasant, and every thing connected with the machinery continued to work smoothly and satisfactorily.

To many of the guests the matter was an entire novelty, and the interesting character of the invention arresting the attention of every inquiring mind, it was truly gratifying to observe the pleasure excited by witnessing the operations of the machinery.

It has been a source of much pleasure to us, who have seen the progress of this boat from the first—to observe the ingenuity with which every difficulty has been overcome, and every new obstacle surmounted by Mr. Bennet, who has, through the whole, shown himself to be as enterprising and persevering as he is skilful and ingenious. Those who only see the boilers in their present more complete arrangement, can form no idea of the laborious and tedious steps to be gone through in order to obtain it.

The boat reached a point, about a mile distant from Sandy Hook, in two hours, and then returned.

At this time a very beautiful phenomenon exhibited itself. The wind, by the change in the course of the boat being now astern, the masses of vapor which, issuing at each stroke of the piston, had before been blown rapidly away, now start up in wreaths which, expanding into perfect circles, sailed away, growing larger and larger, and remaining distinct and well defined to a great distance. This most beautiful appearance continued for some time, and was repeated when the wind was again in the proper direction and not too strong After witnessing the highly gratifying operations of the machinery for more than 25 miles, and enjoying the delightful breeze, which tempered the otherwise almost insupportable heat of the atmosphere, the company organized a meeting. When the officers had taken their seats, a committee was appointed to draw up resolutions indicative of the high satisfaction of the company. Mr. Andrew Williams, in presenting these resolutions, made some very happy remarks, in which he justly complimented the ingenuity of the inventor, Mr. Bennet; and the enterprise of the proprietors Capt. Cobb and others. The resolutions being unanimously adopted, the Rev. Dr. Cox being called upon, made some very pertinent allusions to the progress of steam navigation. He referred to the remark of Homer, that the ocean had been placed between lands for ever to separate and disconnect them, and that the transit of the ocean might be placed in the same category with a voyage to the moon. Dr. Cox also dwelt upon the mutual assistance of the Arts and Sciences, and upon the moral benefits conferred by their united powers.

On reaching the starting place, it was found that since leaving, just *one cord and one quarter* of wood had been consumed during the trip. The distance in a direct line, to and fro, is called 34 miles—the course taken by the boat being indirect, may make the whole distance nearly 40 miles. This was accomplished in three hours and three quarters.

The almost incredible saving in fuel is the grand point in Bennet's invention. At this rate, the Atlantic may be crossed with a consumption of little more than 100 cords of wood, or its equivalent in coal—the saving in stowage will of course be in proportion. We understand from Mr. Bennet, that the entire weight of machinery and boilers full of water is not quite 70 tons, or actually a *smaller weight than the water alone* in the boilers of the *Great Western*; and it must not be forgotten that the engines of the *Dispatch* are by no means inferior in workmanship or strength. Her cranks, for instance, are of the same weight as those of the *Great Western*—the entire saving of the space occupied by the condensers, air pump, &c. of the latter; being only counterbalanced by the room occupied by the blowing cylinders of the former—leaving a great difference in favor of Mr. Bennet's arrangement.

The boat passed up the river a short distance—flinging around her beautiful garlands of vapor, and finally returned to her place of starting. After the boat was made fast, Mr. Bennet desired the attention of the gentlemen to one of the peculiar advantages of his boiler, viz: the effect of the gases of the fuel, and condensed atmosphere produced by his blowing apparatus. He now removed the slide valve and cap of the *fuel pipe*, when a rush of the condensed air, gas, and smoke contained in the furnace, took place with a tremendous blast for a moment, when all noise ceased. This operation, however, in no wise affected the steam in the boiler or steam chamber, except so far as that, in again starting the boat, the steam then in the boiler would not have the direct and powerful aid of that portion of highly rarified air which the furnace contained when the machinery ceased to move—as, on being relieved from the pressure in the furnace, the "cap valve," which regulates the intercourse between the furnace and boiler, is forced down by the pressure of steam in the chamber, and closes all direct communication between them, until the blowing apparatus and fire have produced a pressure *in the furnace* sufficient to raise the "cap valve," thereby opening a passage for the gases and smoke into the water, when they become a part and parcel of the steam, or working power; or, in other words, the pressure in the furnace, when the blowing apparatus is in motion, and the combustion rapid, is greater than the pressure in the boiler; consequently, the current is from the furnace into the boiler, but the moment the pressure in the furnace ceases, all communication between them is closed by the pressure in the boiler. The relative pressure is as 45 in the furnace to 44¾ in the boiler.

This boat has two boilers—the exterior case of the largest is 14 feet in height, by 5 feet in diameter: the interior case, which forms the furnace, is 9 feet high and 3 1-2 feet in diameter, giving a space of about 11 inches in thickness by 10 feet high for the water; the other boiler is about one quarter less—the large one only was used during this excursion, after the boat was under way.

This construction of boiler is peculiarly calculated for Locomotive Engines, as there is not a particle escaping from the smoke-pipe, or steam pipe, which is not contained in the escape steam; of course those very important appendages, ladies' dresses and gentlemen's eyes, cannot be materially damaged thereby, as is now generally the case when within a quarter of a mile of the engine. We therefore enjoin it upon Mr. Bennett, to call upon the gentlemen of the Harlaem Railroad, and give them an opportunity of testing its peculiar appropriateness for that purpose.

The question has often been asked, and it is a very natural one—how are such results produced by so small a quantity of fuel? The answer is, that by the arrangements of Mr. Bennett's Machinery, he avails himself of the combined power of fire, water and air, and of the latter a very large quantity.

The success of this experiment gave to the gentlemen guests *far* more satisfaction than the liberal and well arranged entertainment which was spread before them by the proprietors, Capt. Cobb and others; although an *unpartaking* observer might, in his spleen, have said that the good things on the table, for a time at least, attracted the most attention.

Mr. Bennett gave, with great clearness and politeness, to all who asked, a description of the whole machinery; and even if he is, as observed by a foreign editor on republishing the first brief description from the New-York American, in 1836---"an illiterate mechanic," we do not hesitate to say, that he is a man of uncommon intelligence on this subject, and that the name of PHINEAS BENNET will, in after times, stand conspicuous among the benefactors of his country and of mankind.

We must not, however, in our admiration of the genius which discovered the mode of applying this combination, overlook those gentlemen who had the sagacity to appreciate his worth, and the liberality and moral courage, amidst the sneers of pretending ignorance and self-importance, to aid him in carrying out his plans, by furnishing funds-.-the *want* of which has, in many instances, deprived mankind of improvements of incalculable value—and inventors of their just rights and deserved reward. Amongst those who have been conspicuous for their unwavering confidence and liberal aid in carrying Mr. Bennet thus far through his difficulties, we could, if at liberty, name one gentlemen of Ithaca, who deserves great credit; but his modesty is equal to his liberality, and his greatest pleasure will be, we are sure, in the success of the man whom he has so liberally aided; and therefore we will not particularize where so many are entitled to a share of praise.

The company, after giving three hearty cheers for the success of the enterprize, left the boat, highly delighted, and as far as we could learn, *convinced* that this is a matter of the utmost importance, and demanding the serious attention of the community.

Will not some of our enterprizing merchants unite in building a *Great Eastern*, able to carry as much merchandize as one of our packets, more passengers, and accomplish the voyage in as short a time as her transatlantic rival, and at infinitely less cost?

The proceedings of the meeting we give below :—

*New-York, June* 12, 1838.

At a meeting of the invited guests to take an excursion on board the new Steamer Despatch, to test the usefulness and excellence of the recent invention of Mr. Phineas Bennet, in the application of steam, R. Lockwood, Esq. called the meeting to order, and nominated D. Leavitt, Esq. President; and Capt. M. C. Perry and Ruebens Peale, Esq., Vice-Presidents—Messrs. Joseph Cowdin and Henry A. Wells, Secretaries.

A. Williams, Esq. moved that a committee of five be appointed to report resolutions expressive of the sense of the meeting, whereupon R. Lockwood, A. Williams, R. R. Lansing, T. B. Wakeman, and John T. Griscom, Esqrs. were appointed said committee, and reported the following resolutions, which were unanimously adopted:—

Resolved, That we have witnessed with pride and gratification the present experiment with Bennett's new steam boiler, and from our present personal observation, we deem the invention entitled to high public favor and consideration.

Resolved, That the enterprizing inventor, Mr. Bennet, and the indefatigable proprietors, Capt. Cobb, and others of the Despatch, deserve the thanks of the public for their zeal, perseverance and success, as evinced by the present experiment.

Resolved, That as Robert Fulton effected one revolution in navigation by the application of steam power, we deem that Phineas Bennet has this day commenced another of equal promise, by the economy of his mode of generating steam.

Resolved, That the polite invitation and hospitable entertainment of the proprietors on board their steamer to Sandy Hook, and return, deserve and receive our warmest acknowledgments.

Resolved, That the proceedings of this meeting be published.

The meeting was eloquently addressed by A. Williams, Esq. and Dr. Cox, in which the vast importance of improvements in steam navigation, and the advancement of the mechanical and useful arts of peace were illustrated with happy effect.

D. LEAVITT, *Chairman.*

M. C. PERRY, REUBENS PEALE, } *Assistant Chairmen.*

JOSEPH COWDIN, HENRY A. WELLS, } *Secretaries.*

☞ In our next number, we shall refer again to this subject, giving an account of an excursion to the Fishing Banks, on the 19th, and another up the Hudson, on the 22d of June.

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*Return of the Steamers, Great Western and Sirius.*—We have the pleasure of announcing to our readers the safe return of these vessels. The Great Western had a passage out of 14½ days. The passengers all bear testimony to her safety, and to the politeness of the commander, Capt. Hosken. The Great Western left Bristol on the evening of the 2d of June, and arrived here on the morning of the 17th, making the passage in less than 15 days. There seems to have been much enthusiasm excited by the success of the experiment. The Great Western Railroad was opened on the 21st of May—on that occasion "the success of the Great Western Railroad, terminating in New York," was drank.

The *Sirius* arrived from Cork on the 18th of June, having left on the 31st of May.

The entire success of this new enterprize is established. It is said that numerous Steam Navigation Companies are already forming in England.

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*Hiwassee Railroad.*—It is truly gratifying to learn, that in every section of the country the right spirit prevails in relation to works of Internal Improvement. The annexed notice of the Hiwassee Railroad is from the Athens Tennessee Journal, of 30th of May.

"Let any one who doubts the progress of the Hiwassee Railroad, ride along the line from Squire Renfrow's to the Tennessee river; a distance of 33 miles, or one-third of the whole road. He will see several miles completed, and some two or three hundred laborers busily employed in levelling the remainder. It is pleasant to see such energy on the part of the road, and still more so to reflect on the advantages that East Tennessee is to derive from their operations. The pledges of Georgia assure us that she will not let us slacken our exertions; while the relief which we will soon receive from our own State, will enable us to proceed with still greater vigor. The stockholders are catching the spirit from the States, and express their full determination to abide by the cause; a very few only remain in the ranks of opposition, prominent marks for the finger of contempt and pity. A close investigation into the *real* objects of these few, would serve to place them in a very unenviable light. It would no doubt lead in every instance to private personal interest, in opposition to a noble and generous feeling for the welfare of the public." A. D.

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[From the Savannah Georgian of the 2d June.]

*Central Railroad.*—Our readers will have an opportunity this morning of riding *twenty-seven* miles on this road, and as the locomotive starts from "the depot," they will be saved the former walk. The monument of earth being finished, an excursion is more inviting. Hope to be there.

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*Civil Engineer and Architects' Journal.*—We have received through Mr. Jackson, the agent, 104 Broadway, the first six numbers, or two quarterly parts of the Civil Engineer and Architects' Journal, a new monthly work, published in London, devoted mainly to Internal Improvements, and Architecture, Science, &c. It contains many interesting and useful articles, as we shall frequently give our readers evidence by extracting from its columns, as we have in this number.

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☞ We ask particular attention to Advertisements on the *cover.*

# AMERICAN
# RAILROAD JOURNAL,
AND
# MECHANICS' MAGAZINE.

No. 2, Vol. I. New Series. ] JULY 16, 1838. [ Whole No. 314. Vol. VII.


*To Subscribers, Engineers, Officers of Railroad and other Companies, and Gentlemen connected with the cause of Internal Improvement and Manufactures.*

It having been for a long time past desirable that one of the Editors of this Journal should visit the various public works and manufactories of the United States, we announce to our readers that arrangements have been made which enable us to commence such an undertaking.

During the present and ensuing month, it is the intention of one of us to visit the public works in New-Jersey, Pennsylvania, Delaware, Maryland, and the District of Columbia, and if sufficient encouragement is offered, by the payment of balances *now due* for, and an *increased circulation* of, the Journal and Magazine, to extend our tour at the present, or at an early period, over the whole Union. The object being to collect materials for a full and accurate description of all such works, embracing the plan of construction, and their present state, we desire to obtain the aid and assistance of Engineers, Directors, and all others interested. Every thing connected with Internal Improvement and Manufactures, coming under our observation, shall be noticed in a proper manner. By this means we shall not only increase the value of our Journal to its readers, but be enabled to give to the world notices and accounts of many objects of interest hitherto unnoticed and unknown.

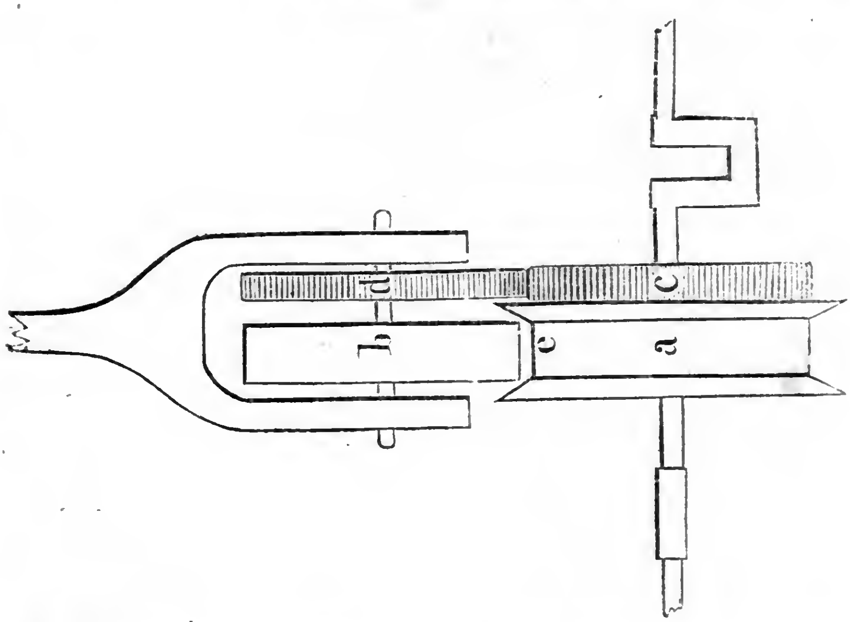
☞ As one important object of this excursion is to collect accounts now due for our periodicals, we particularly request Subscribers to be ready and prompt, in order that we may be seconded in our endeavours to increase the value of the Journal.

## *Inclined Planes.*

*Boston*, *April* 9, 1838.

To the Editors of the Railroad Journal:

Gentlemen—I submit, with the view of eliciting the opinions of those of your professional readers who have constructed, or have the management of Railroads on which *inclined planes* exist, the following modification in this mode of action, provided you consider it of sufficient interest. The subject is at least one of considerable importance; and I feel that engineers will generally concur with me, when I say that notwithstanding the unreasonable stigma under which inclines labor at present, they form an exceedingly important auxiliary to railroads, under particular circumstances, and cannot then, (as when crossing an extensive ridge) be avoided without a great sacrifice of time and direction as well as economy. The many accidents however which have happened, and which in a majority of cases I cannot but attribute to the neglect of that efficient and constant attention, which like any piece of machinery, they ever require, has prejudiced the public mind against them. The self-acting incline, however appropriate occasionally to private roads, where the daily amount of travel and the weight of the trains can always be regulated, may be said to be altogether out of place on a public, and therefore fluctuating thoroughfare; I have therefore in view at present a comparison simply with those inclines where some motive power, whether of water or steam, is stationary at the top, for the purpose of dragging the trains up the incline. On such inclines there are generally two distinct tracks, and to each track a separate rope; the drums on which these ropes are rolled and which are set in motion by the fixed engine, act alternately to move the ascending train; the rope which is not in action for this purpose being dragged or unrolled down to one track; while the other is hauling the ascending train up the other, the descending rope, if there is a heavy descending train, assists the engine, by an appropriate gearing of the two drums. If there is no train descending, it is drawn out by a waggon used for that purpose, the return of which to perform the same service forms a subtraction from the useful effect of the engine. Another mode of action on such inclines is to apply, by means of a series of friction wheels, an endless rope as on the incline at Liverpool; and this mode, provided the rope is sufficiently strong, admits of the ascent of more than one train at a time; the loss of power however is great, in consequence of the friction necessary to ensure the constant revolution of the rope, which in this instance is moved solely by friction. According to Dr. Lardner, the rope on the Liverpool incline breaks very frequently, occasionally so often as twice in the same day. On either of these inclines the rope itself forms part of the weight to be moved, and no inconsiderable part, when taken in conjunction with the friction of the sheaves on which it rests. In proportion to the amount of this friction and strain, the rope itself must be increased in strength. If the mode of action which I suggest could be made to answer, and I by no means assert that it can, the rope would remain at rest on the incline, and therefore this force would not be expended. I shall briefly describe this mode, and then refer shortly to the points in which it differs from the modes in use at present. I must premise that it is contemplated to use a flat rope, instead of a circular one; these flat ropes are in common use on the collieries; they are probably three to four inches in width, and upwards of half an inch in thickness; they are not made by hand but by a very ingenious machine, patented by a Mr. Grimshaw, of Sunderland, in England, and their most valuable property, and indeed that which has rendered them so generally useful, is, their perfect freedom from twist. While the circular rope was in use in the collieries, the baskets of coal ascending the shafts were continually revolving, the varying weight producing naturally the effect on the twist, uncoiling it to a degree with the loaded basket, and the elasticity of the rope resuming its former state as it descended with the empty one. This evil was of little consequence when coals were drawing, but as the same shaft and basket were used by the workmen in ascending and descending, it required some practice and a very steady head to be able to endure it; the flat rope has entirely removed this evil. My design, then, supposes that a flat rope is laid on the incline instead of a circular one; this rope to lie on occasional rests, raised a few inches above the ground; to prevent the surface water soaking into the rope, and also to ensure perfect freedom from particles of gravel or earth which cut its fibres—there would be no engine at the top of the incline, and the machine for moving the train, or *the rope engine*, would be moveable on a frame and wheels as the machinery of locomotives are at present; the rope would not be rolled up by the engine in its progression up the plane, but would merely be used successively, and then dropt behind on its former ground.



In the figure, *a* and *b* are wheels of equal diameters, connected by the toothed wheels *c* and *d*, also of equal diameters; to the cranks on the axle of the lower wheel the connecting rods of the engine are supposed to be attached in the usual way; as the wheel *a* revolves, the wheel *b* will obviously perform equal revolutions in equal times, but in an opposite direction; both wheels therefore moving in equal times, and as respects their *peripheries* at the opening *e*, in the *same* direction will have a tendency to draw in, or to pass any substance which should be placed in the opening *e*, of sufficient thickness to ensure contact on either side, and pressure in proportion to the weight of that substance, or to the load moved. This would appear to be sufficiently obvious, and it is here that it is proposed to apply the flat rope, the opening *e* occurring on the real machine or car, probably two feet above the road-bed. As the revolution of the two wheels *a* and *b* caught the rope, and therefore the rope being fixed, induced the progression of the car on which the machine is placed, it would immediately after passing through, fall to the ground, resuming its former position on the rests. The ropes, however, used at different times on the same incline, might vary in thickness, and the upper wheel *b* must therefore be capable of variation, as well as with a view to this object as to ensure the pressure or friction necessary to prevent the rope from slipping with a given load; this would be effected by the heavy frame on which the upper roller is fixed, (and would as well slide on the frame of the lower roller, not shown here) being terminated by a screw; this screw being connected with an elliptical spring, to meet occasional variations in the thickness of the same rope—any pressure could thus be communicated to the rope, and consequently any degree of hold secured; but if the metallic surface of the rollers were used, the rope might become glazed, and the increased pressure necessary on this account might damage its fibres; it would be proper therefore to cover the peripheries of the wheels or rollers with a certain thickness of leather; it is possible that leather might answer best for the rope itself, in the manner of traces of carriages.

If I have made this description intelligible, it will be seen, that provided the application is practicable, the weight of the rope would not, as heretofore, form an item in the power required for an inclined plane; the strain on the rope would be reduced in proportion to this weight, and, in fact, in a much greater proportion; there would be no objection to using a very heavy and very strong rope, since the portion lifted by the machine would be so small, as to be unappreciable in this respect; the first cost of the machinery would be much less than at present—there would always be two of these machines, and when one was out of repair, the other would fill its place, and should there be other inclines on the same road, one of these machines could be applied indifferently to any incline, since the mode of action would be the same on every one. Provided the rope were sufficiently strong, several trains might be moving up at the same time, since the application contemplates the detachment of the machine from the rope, at the head of the incline, which could very well be effected without interfering with the action of the other trains; the time, however, occupied in ascending inclines of ordinary length, is generally so short, as to render the propriety or necessity of two trains on the same rope rarely advisable. Two tracks are still contemplated; neither we believe should ever exceed such an inclination as will not admit of a waggon descending safely by the power of the brake; one of the tracks at, any rate, should if possible be so proportioned, and the machine after performing its duty, as well as all carriages or trains for the descent, should descend by the clear track; there would consequently be no time lost in waiting on this account—the length of rope therefore necessary to the second track would be saved, as well as the sheaves; but the principal advantage would be the action admissable on the one track, independent of the other; and a greater advantage would be the simplification of the entire machinery.

The pressure upon the rope necessary to ensure such a mode of action as this, would be very great; and the question is, whether that pressure would not injure the fibres of the rope; and if it should, the question again arises, whether the simplification of machinery, and its attendant advantages, are sufficient to induce the substitution of another material in lieu of hemp, and which would not be liable to this objection. If the suggestion is of any practical importance, some of your readers may take sufficient interest in it, either to substantiate or explain their objections: I have probably said more than enough to draw their attention to the subject.

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### *New Railroad Route between Easton and New York.*

[The following communication from Mr. L. F. Douglass in regard to the Mine Brook Railroad and Transportation Co. will be found worthy of attention. From this it would appear to be a better route than any yet proposed for the Transportation of Coal to this city and vicinity. What will our friend *Clinton* say to this—will it not meet his views? Few routes can present so desirable an opportunity for capitalists; we wish that all interested in the cause of Internal Improvements should look to it.]

In conformity with the provision made in a charter granted by the Legislature of New-Jersey, under the name of the Mine Brook Railroad and Transportation Company, at its Session of 1836 and '37—the exploration of the route, which was entrusted by the Commissioners to the subscriber, has been completed, which commences upon the line of the New-Jersey Railroad, either at Newark or Elizabeth Town, in Essex Co., and thence passing in almost a direct line through Springfield, Basking Ridge, Germantown, Clinton, &c. in the rich counties of Somerset, Hunterdon, and Warren, terminates at Easton, Pa.

From this examination, a more favorable result has been obtained than the most sanguine of its friends were led to expect. The distance from the Hudson to the Delaware rivers will be under 75 miles—maximum grade not to exceed 48 feet per mile—the most abrupt curvature is 1000 feet radius, and this very seldom occurs, not generally ranging below 1500 feet. These considerations, so indispensable to the successful prosecution of heavy transportation, cannot, I am confident, be embraced in any other route proposed or in contemplation between the city of New-York and Easton; and I hazard nothing in the prediction, that whatever course a Railroad may traverse in connecting the two points contemplated, *this must* and *will* eventually be occupied as the great channel of communication between these two points.

The Susquehanna and Delaware Railroad commences at Pittston on the Susquehana, and running east, strikes the Delaware at the Water Gap—from thence by an extension of its charter they are at liberty to continue the line as far as Easton. This project has been partially progressed in, the exploration of the route having been made, and a large part of the capital stock subscribed; and it is the intention of that Company to proceed with the undertaking as soon as arrangements can be completed for that purpose. By a connection with this, or other existing and proposed lines, an entire Railroad communication may be had to the Suequehanna, passing in its course through the rich and inexhaustible coal mines of Luzerne, and striking upon the Susquehanna at a point that will inevitably ensure a participation in its extensive trade. From this point, following the line of communication already either in operation or in contemplation to be made, will extend this important improvement to the line of the Erie Railroad.

As the Report of the Engineer, which is now under way and will shortly appear, will enter more largely into the investigation of the particular routes to be adopted from Easton, with the detail in connexion, it was not thought advisable in this notice to anticipate its appearance with a particular description of its facilities.

There are many considerations in this proposed improvement which claim for it, and will receive the attention of your citizens.

L. F. Douglass, *Eng. Mine Brook R. R. & Tran. Co.*

*June* 6, 1838.

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The suggestions in the following extract are very good:

While writing, may I suggest to you what I think will be an advantage both to your subscribers that may wish to avail themselves of the advantages of the labor-saving inventions, and to the inventors of such machines; and that is, in your publication or notice of them, inform us who manufactures them—where the inventor resides—his post-office—what agents he has (if any) in the *sea-port towns*, and the manufacturer's price. I would readily avail myself of several useful machines, noticed in your Mechanics' Journal, did I know how to procure them. To apply to a person residing a great distance from a sea-port, even at such a place as Albany, is not only inconvenient, but in many cases impracticable, both in the application and in the forwarding the machine. Every invention proven to be useful, or possessed of advantages that speak for themselves, should be placed within the reach of every citizen who may desire to possess them; and to do this, there should be an agent fixed in one or more sea-ports, from whence they can be readily sent. To apply to the interior of a State for a small machine is out of the question with us here; and I think you would benefit some of the numerous inventors, were you to suggest in your periodical the advantage they would derive from selling their inventions at a moderate and reasonable price, that would induce many to buy, who now refuse on account of the high price, particularly new and unestablished inventions.

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## *Rise of the Juniata.*

The Freshet and State Works.—Extract to the Editor of the Philadelphia Inquirer, dated

"Canal Room, June 25, 1838.

"Dear Sir,—I hasten to give you the particulars, so far as we have heard them, of the ruinous flood upon the Juniata. No injury has been done below the mouth of the Raystown branch; but above the dams are all injured, and the guard locks rooted out, or so damaged as to require them to be rebuilt. It seems the weirs of the dams were too short; they should be extended to give more width for the passage of the water. It is thought by the engineer, Mr. Bayley, who fortunately happened to be on the spot, that $250,000 will let the water into the canal, and allow the passage of the boats; but this cannot be done under three months. The whole cost of putting it into complete order again cannot be less than $400,000. The river rose fifteen feet plumb water at Williamsburgh in less than fifteen hours. Messrs. Stephens and Dickey are there, and Mr. Pennybacker started yesterday. The utmost promptness will be used, and if *human* means can accomplish the repairs in less time it will be done."

We learn from the New-Jersey Journal, that the New-Jersey Railroad Company have declared a dividend of 3 per cent., payable on the 16 inst.; and also from the New-York Times, that this Company is doing every thing within its power to accommodate the public. On Tuesday next an *extra train* will leave New-York at 11 o'clock A. M., return from New Brunswick at 5 P. M.; thereby giving passengers an opportunity to dine at New Brunswick, hear Mr. Everett's oration, and return to this city by sunset.

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From the Civil Engineer and Architects' Journal.

## *Curtis's Railway Chairs.*

The form of the rail R, and chair C, as shown in Fig. 1, is the same as those now in use; but the space for the key is made rounding in the middle, as shown in Fig. 3.

Fig. 1.

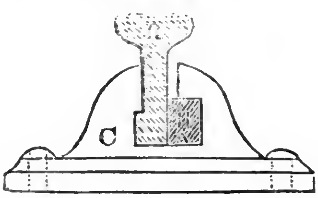
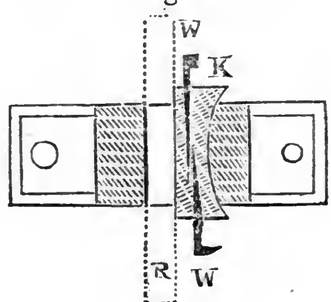



Fig. 3.



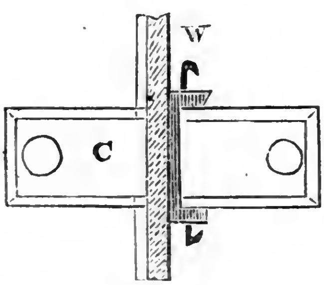




Fig. 2

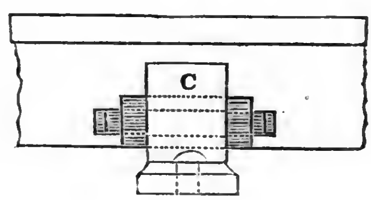


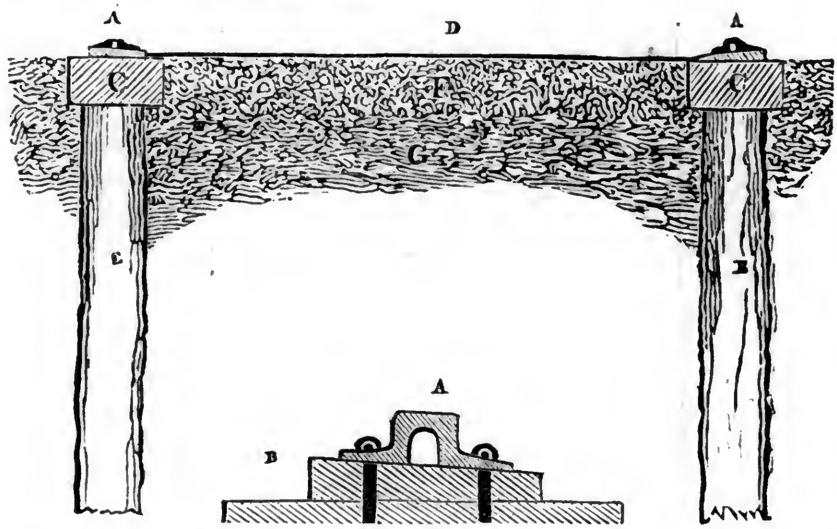

Fig. 4.

When the rail is in its place, a piece of straight grained oak, K, is driven into the key-way, and then folding wedges, W, with claw heads, are driven both sides into the oaken key; thus, the wood becomes violently compressed, and adapts itself to all the conditions of the rail and chair; and for the joint chairs, it will make no difference what may be the variations or twist in the two rails, as the wooden key will, in every case, adapt itself to circumstances, the wedges are drawn back by a set hammer, when it is necessary to take up a rail; this method will hold a rail much more steadily than either an iron or wooden key solely; the shake or jar produced by the train passing over the rails, will not affect the wedges, and they will always remain tight, particularly if care be taken to drive in the wooden keys, when they are dry, the elasticity also of the timber admits of driving the wedges tight, without breaking the chairs; it is thus clear, that the rails of every railway, of whatever figure they may be, can be secured in this manner without any difficulty; in fact, this method is not only better, but cheaper than that usually adopted.

Fig. 1 is an end view; Fig. 2 a plan. Fig. 3 a plan showing the form of the key-way and key when the wedges are driven; Fig. 4, side view.

*Construction of the Great Western Railway.*

This railway, on account of its deviation from the ordinary mode of constructing railways, is watched with considerable interest by the profession and the public; it is our intention to collect as much information as we can, and lay the same before our readers; we have taken the earliest opportunity of obtaining the particulars of the method of laying the rails, which we illustrate with an engraving.




EXPLANATION OF THE ENGRAVING.

A A wrought iron rail screwed down to the sleeper; B a feather-edge or wedge shaped board of oak; C C sleepers of timber; D iron tie-bar to connect the two sleepers; E E piles eight feet long, and eight inches diameter, pointed at the lower ends; F ballasting, G embankment.

*Formation of the Railway.*—On the embankments, piles of beech trees Kyanized, about eight feet long and eight in diameter, are driven by a pile engine, at distances of fifteen feet apart, on each single line of rails, and so arranged that the piles of the corresponding rail are placed opposite to the intermediate distances, and not opposite to each other thus: o ° o ° o upon these piles are laid longitudinal continuous sleepers of Memel timber Kyanized, thirteen or fourteen inches wide by six and a half or seven inches thick, which are firmly bedded on the ground, previously made even and well rammed: on the top of the sleepers are laid the rails, with an intermediate distance of seven feet half an inch in clear of the rails: between the rail and the sleeper is a feather-edge or wedge shaped board of oak, or hard wood, eight inches wide and one and a half inch thick on the outer edge, and one and a quarter inch thick on the inner edge, which gives the rails a slight pitch iuwards, so as to make the top coincide with the levelled or conical rim of the wheels, which touches the rails with a bearing equal to the width of the top of the rails, instead of a point, as in the ordinary mode of laying them. The rails are of wrought iron, rolled in lengths of fifteen feet, as shown in figure 2, and made hollow; the top is two inches wide, base six inches, and height one inch and three quarters; holes are punctured in the flanges on both sides, about eighteen inches apart, to secure the rail *(withont chairs)* to the sleepers, by means of screws eight inches long. To prevent the sleepers from spreading, there are, at every fifteen feet, iron ties across the railway, spiked down at each end to the sleepers; the surface of the roadway is finished with ballast in the usual manner.—*Ib.*

*Semi-Annual Report of the Water Commissioners. From the* 1st *of July to* 30*th December*, 1837, *inclusive.*

BOARD OF ALDERMEN, JANUARY 4, 1838.

The Water Commissioners presented their Semi-Annual Report, from the 1st of July to the 30th December, 1837, inclusive; which was laid on the table, and directed to be printed for the use of the members.

THOMAS BOLTON, Clerk.

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To the Honorable the Common Council of the City of New-York:

In accordance with the provisions of the Act of the 2d May, 1834, and of the Act of the 5th of May, 1837, the Water Commissioners respectfully report:—

That they have presented to the Comptroller an account current, showing the receipts and disbursements of the Commissioners, from the first day of July last, to the 31st day of December, inclusive, which has been compared with the books kept by the Comptroller, and found correct.

The total amouut expended from the commencement of the operations under the "Act to provide for supplying the City of New-York with pure and wholesome water," is as follows:

| | |
|---|---|
| From July, 1835, to January, 1836 . . | $31,828 02 |
| " January, 1836, to July, 1836 . . | 12,070 84 |
| " July, 1836, to January, 1837 . . | 28,099 58 |
| " January, 1837, to July, 1837 . . | 62,602 85 |
| " July, 1837, to January, 1838 . . | 233,856 93 |
| Total amount disbursed to the last date . . | 368,458 22 |
| Balance in the hands of the Commissioners . | 5,124 45 |
| Grand total of requisitions on the Comptroller | $373,582 67 |

The following is a synopsis of the sums disbursed by the Commissioners from the first of July to the thirty-first of December, 1837, inclusive, presenting a condensed view of the several objects for which the money has been paid; but rendered more in detail by our account current, presented to the Comptroller:

| | |
|---|---|
| Paid for land, embankment, office lot, and right of way | $47,419 74 |
| Paid the contractors on the aqueduct . . . . . | 169,152 00 |
| Paid salaries to Commissioners . . . . . . | 2,750 00 |
| Paid salaries to Engineers, and for the incidental expenses of the corps . . . . . . . . . | 11,382 07 |
| Paid for advertising, printing and stationery . . | 325 54 |
| Paid for incidental expenses of Commissioners, and salary of their Clerk . . . . . . . | 693 58 |
| Paid for Chancery expenses and searches in the titles of lands for the aqueduct . . . . . . . | 2,134 00 |
| | $233,856 93 |

In our report to your honorable body of the 3d of July last, we stated that offers to contract had been received on the 26th of April, 1837, for the whole of the sections on the first division of the aqueduct, including the dam of the Croton Reservoir; but that the state of the monetary concerns of the city and country, induced us to accept of offers for only thirteen sections of the work, amounting in the aggregate to $921,695, which under the circumstances alluded to, was deemed as large an expenditure as the nature of the case would warrant.

The reasons for thus restricting the contracts, having in a great measure ceased to exist, and the Engineers having completed the plans and specifications of the work on the second division of the aqueduct, the Commissioners proceeded on the 8th of August last. to give notice, by advertisement in the public papers, and by printed circulars, that proposals would be received until the 5th of September, 1837, at their office in the city of New-York, for furnishing the materials and completing twenty-seven sections of the second division, and ten sections of the first division of the Croton Aqueduct.

In the bids made for the work to be performed, in accordance with the aforesaid notice, there was a fair competition among those offering to contract, varying from eight to sixteen in number for each section. The owest offers accepted were as follows:

| | |
|---|---|
| FIRST DIVISION. | |
| 9th section, S. Roberts | $69,385 |
| 10th do. do. | 49,672 |
| 12th do. Yates & Hollister | 53,985 |
| 13th do. do. | 59,550 |
| 14th do. Brown & Bivens | 67,510 |
| 16th do. Ferrill, Hays & Ellis | 56,957 |
| 19th do. George Clark | 43,845 |
| 21st do. Delano & Carmichael | 45,594 |
| 22d do. Rutter & do. | 63,984 |
| 23d do. James Appleton | 74,809 |
| 24th do. do. | 37,279 |
| 25th do. S S. Riddle | 44,452 |
| 26th do. John P. Brayton | 28,055 |
| SECOND DIVISION. | |
| 27th section, John Burrell | $41,006 |
| 28th do. George Clark | 37,447 |
| 29th do. James Appleton | 44,153 |
| 30th do. Francis Blair | 47,025 |
| 31st do. do. | 39,657 |
| 32d do. George Law | 30,855 |
| 33d do. do. | 102,310 |
| 34th do. Taylor & Brady | 40,803 |
| 35th do. do. | 41,449 |
| 36th do. Weed & Conklin | 37,923 |
| Carried up | |

| | |
|---|---|
| Brought up | |
| 37th Weed and Conklin | 53,460 |
| 38th do. O. & E. Davison | 43,435 |
| 39th do. do. | 30,820 |
| 40th do. W. Estabrook | 37,932 |
| 41st do. Roberts and Luud | 30,823 |
| 42d do. R. W. Estabrook | 41,352 |
| 43d do. Case, Delano & Ward | 49,278 |
| 44th do. S. S. Riddle | 29,724 |
| 45th do. Campbell & Bishop | 81,126 |
| 46th do. E. Learned & Co. | 31,179 |
| 47th do Banker, Veeder and Clute | 37,488 |
| 48th do. Milligan, Gilbert and Co. | 43,513 |
| 49 do. Ferrell and Ellis | 50,256 |
| 50th do. do. | 36,908 |
| 51st do. Burnham & Lobdell | 49,611 |
| 52d do. James Thomson | 73,952 |
| 53d do. Banker & Co. | 55,600 |
| The first letting, exclusive of the dam, was | 1,934,162 |
| The late contract for the dam hereafter explained was | 85,389 |
| Making the total am't under contract | $2,823,691 |

We beg leave to refer to our last report for an explanation of the method pursued in computing the several prices for which the different descriptions of work were offered to be performed.

It was found, on a further examination of the site selected for the Croton Dam, that it was not so well suited for the purpose as a location about 400 feet further down stream, and it was therefore, on the recommendation of Mr. Jervis, the Chief Engineer, decided to erect the said dam at the latter place, and to abandon the former location. This change of site made it necessary that a change should be made in the structure;

the effect of which would be to lessen materially the mason work of the dam, while it increased some other portions of the work, but of a less expensive description. The contractors, urging this change of plan as a reason, proposed abandoning the contract; and although the Commissioners were satisfied, that by the terms of the agreement, the contractors were bound to proceed with the work, notwithstanding the alteration of the plan, they nevertheless consented to a new letting of that part of the work, believing there would rather be a gain than a loss to the public by the operation. Notice was accordingly given in the usual way, on the 3d of October last, that sealed proposals would be received by the Water Commissioners, until the 6th of November, ensuing, at 3 o'clock, P. M., at their office in the city of New-York, for erecting a dam across the Croton River, with other incidental work on that portion of the Croton Aqueduct, embraced in SECTION ONE on the first division of said aqueduct

In accordance with the foregoing notice, there were seven proposals presented to the Commissioners on the 6th of November, aforesaid, for constructing the dam; the lowest of which amounting to $85,386, was accepted, and a contract entered into accordingly, with Henry N. B. Crandall, and William W. Van Zandt, with the requisite sureties, for the work and materials necessary to the completion of the structure. The original amount of contract for erecting said dam, at the site selected by Major Douglass, was $117,458; making a saving to the city of $32,169 by the change of location.

We are compelled to omit the details concerning the appraisal of the land. The circumstances attendant upon this portion of the duties of the Commissioners, are of the most vexatious nature. No opportunity of thwarting them appears to have been omitted by certain of the landholders —the list of awards will show what enormous prices they have given.

The Report also alludes to certain statements calculated to mislead and prejudice the inhabitants against the work—they in a joint affidavit made declare that the deponents had lost almost the entire product of their farms. It appears from the separate affidavits of several of these individuals, obtained by the Commissioners, that they were made to say things very different from their intention. It seems that one had some apples, another a few rails, and a third some ears of green corn stolen, but whether by the laborers on the work, or not, they were unable to say!

The Report pays the following compliment to the contractors:

The Commissioners cannot forbear expressing their entire satisfaction with the conduct of the contractors and their workmen, thus far; and that it has been in their power so amply to rebut the calumny which has been attempted to be cast upon them, is to the Commissioners as it must be to your honorable body, peculiarly gratifying.

Agreements in addition to those stated in our last report, have been concluded with the persons named below, for a right of way across their land to the aqueduct, and for other purposes, viz.:

| | |
|---|---|
| With Joseph Hunt, for three years right of way over his land, with the privilege of removing earth for embankment, | $550 00 |
| Thomas Tompkins, for three years right of way . . . | 150 00 |
| Carried over, | $700 00 |

| | |
|---|---|
| Brought over, | $700 00 |
| Abraham Leggett, for three years right of way . . . . | 300 00 |
| Edmund Bird, for the same . . . . . . . . . | 50 00 |
| Albert Minnerly, for the same . . . . . . . | 160 00 |
| Cornelius Jones, for the same . . . . . . . | 50 00 |
| Isaac Coutant, for the same . . . . . . . | 118 75 |
| Caleb Wildey, for the same . . . . . . . | 150 50 |
| Richard Palmer, for three years right of way, and privilege to remove earth for embankment . . . . . . . | 550 00 |
| Eliza Vanwart, three years right of way . . . . . | 90 00 |
| Stephen B Tompkins, the same . . , . . . . | 26 00 |
| Jasper S. Stymets, three years right of way, and privilege to cut a ditch or drain on his land . . . . . . . . | 300 00 |
| Richard Austin, for three years right of way . . . . . | 90 00 |
| Thomas Boyce, for land in fee for office at Tarrytown : . | 150 00 |
| White & Becker, for building said office . . . . . | 390 00 |
| Aaron Ward, for three years or more of office at Sing Sing | 300 00 |
| | $3,424 75 |

In the appraisement of the 4th of November last, as before stated, there were *fifty-one owners* of separate pieces of land to be appraised, all of which was required for the aqueduct. Twenty-six of these owners have consented to receive the award of the Appraisers, provided the Commissioners shall be satisfied with their title. Twelve of them have produced the necessary certificate, and have been paid the money as follows:

| | | | | | |
|---|---|---|---|---|---|
| Warner Willsee, | for | $3\frac{628}{1000}$ acres | of land, | awarded | $1,800 00 |
| John Storms, | " | $1\frac{799}{1000}$ | do. | do. | 1,250 00 |
| Abraham Acker, | " | $\frac{91}{1000}$ | do. | do. | 475 00 |
| John M. Moser, | " | $\frac{58}{1000}$ | do. | do. | 40 00 |
| Joseph A. Constant, | " | $5\frac{110}{1000}$ | do. | do. | 5,500 00 |
| Isaac Lafurgee, | " | $\frac{458}{1000}$ | do. | do. | 125 00 |
| Warner Field, | " | $1\frac{74}{1000}$ | do. | do. | 760 00 |
| Peter Valentine, | " | $1\frac{376}{1000}$ | do. | do. | 650 00 |
| John Butler, | " | $1\frac{741}{1000}$ | do. | do. | 800 00 |
| William Archer, | " | $\frac{917}{1000}$ | do. | do. | 650 00 |
| Samuel Archer, | " | $\frac{950}{1000}$ | do. | do. | 950 00 |
| Ludlow, Morris & others | | $2\frac{300}{1000}$ | do. | do. | 2,300 00 |
| | | | | | $15,300 00 |

The remaining cases amounting to fourteen are now before the Chancellor, to be proceeded in, conformable to the rules of his Court.

The following statement comprises the principal portions of the work which have been performed during the last season, say from the first day of June to the first day of December last.

Two thousand four hundred and fifty-five feet of the aqueduct is now complete.

There has been erected also about 400 feet of the side wall of the aqueduct ready for springing the arch.

The amount of open cutting and excavation in earth, is 146,760 cubic yards, and the same description of work in rock is 18,272 cubic yards.

The tunnellers had penetrated the rock four hundred and six feet on the first of December, and on the first of January inst., they had extended the work to 653 feet. It is confidently anticipated that several of these tunnels will be completed during the present winter, the work progressing through the intervention of a relay of hands both day and night. The tunnel under contract to Scott & Young, in the village of Sing Sing, is now within a few feet of seeing daylight through it, and a short tunnel of 150 feet under contract to T. N. Ferrell, is cut through from end to end.

Six of the culverts are completed, and five partly finished. They vary in dimensions from two to ten feet span of the arch, and from 50 to 150 feet in length. The inverted arch or floor of the incomplete culverts are finished, so that the flow of water through the brook, passes them freely; and sufficient of the upper arch has been laid to permit the crossing of the valley with the stone embankment.

Foundation wall of the aqueduct, amounting to 12,050 cubic yards and back filling to 10,200 cubic yards has been executed.

In addition, a large amount of materials has been procured for the work, and many items of work performed, for a detailed account of which, we beg leave to refer to a tabular statement prepared by the Chief Engineer, and accompanying this report, marked A.

Here is a respectable amount of work, considering the time in which it has been performed. Its execution has not only given general satisfaction, as to its permanence and durability, through the mechanical operations of combining the various materials into a whole, but also that the practicability of completing the undertaking in a manner and style that will be an ornament to our conntry, and of the highest credit to the public spirit of the city of New York, and its corporate representatives, from whom the project emanated and has received a uniform support, is now beyond a doubt.

A very small number of our citizens, comparatively, have any idea of the magnitude of the work and its progress; the immense amount of mere manual labor which has, and is to be performed, in excavating and tunnelling through almost an impenetrable rock, or of mechanical labor in preparing the materials, and in the erection of the bridges, culverts, stone and foundation walls, with the aqueduct for conveying the water to the city, and other erections of a permanent and durable character: to attempt a description of which by words, is out of the question; they must be seen to be properly understood; and the Commissioners think they may appeal with confidence to those members of your honorable body who made an excursion over the line of aqueduct in the month of August last for the correctness of this opinion.

The operations of the masons was suspended on the 8th of November last, and the work placed in a condition to secure it against the frosts of winter. Provision, is made in the contracts, that no hydraulic masonry shall be laid up between the 15th of October and the 1st of April; but the weather continuing mild, and the importance of forwarding this part of work, as far as possible with safety, induced an extension of the date of suspension to the 8th of November aforsaid.

It will be observed there is a much larger quantity of excavating or open cutting performed, than of any other description of work. This was owing, in a measure, to the pressure of the times, which brought forward a great number of laborers seeking employment; and to meet this emergency, permission was given to proceed with this description of labor, in order that as many of these people as practicable might be employed, rather than confine the contractors to the more important mechanical operations, on which only a few comparatively, could be engaged.

The contractors have been urged to procure as much of the stone for the erection of the culverts, to be prepared during the winter, as practicable, in order that no delay may occur in their construction at the opening of the next season. That part of the work requiring no mortar, such as stone wall for foundation and protection, rock excavation, tunnelling and earth embankment, will progress, during the winter months without abatement.

It became necessary as the business increased upon us, that offices on something like a permanent continuance, should be provided for the accommodation of the Engineers, both at Sing Sing and Tarrytown; and the Commissioners having attempted, in vain, to obtain suitable places for the purpose, they were finally drove to the necessity of purchasing a small lot of ground in Tarrytown, and erecting an office on it, for the accommodation of the Engineers on that division of the aqueduct, at a total expense of $540. They have also taken the lease of an office at Sing Sing, to be occupied so long as an office shall be required for the business connected with the Croton Aqueduct, at a rent for the whole term of $300.

The number of persons attached to the Engineer corps on the first of December, including the Chief Engineer, was twenty-four, they have since been reduced to ten, and will be located as follows; three at the office at Sing Sing, three at the office at Tarrytown, and four, including the Chief Engineer, at the office at New York. The services of these gentlemen will be required in effecting such instrumental surveys as may be necessary in progressing with the work to be performed during the winter; in preparing the proper working plans for the sections now under contract, and forwarding the operations required to expedite the letting of the third and fourth division of the aqueduct, at least as far down as the Harlaem River, and the crossing of that river with the aqueduct bridge.

The Commissioners deem it their duty to state, that the engineer corps, under their able head, have conducted the operations thus far (with some slight exception) with perfect satisfaction. We know of no instance of improper conduct on their part as gentlemen, and we presume there exists a reciprocity of good feeling between them and the owners of the farms through which the aqueduct is to pass. This feeling they are required to cultivate as far as practicable, and to avoid incommoding the inhabitants by any of the operations relative to the works, wherever it can be done without injury to the general plan; and the Commissioners have reason to believe they have acted up to this rule, and evinced a disposition to conciliate, by every proper means in their power, rather than contend in unimportant matters for their reserved rights. The Commissioners will embrace this opportunity of reiterating their continued approbation and confidence in the talents of John B. Jervis, Esq. their Chief Engineer. He has on all occasions, conducted the operations with much scientific knowledge, in preparing the plans and specifications of the work, and with great practical information in its execution; and they entertain not a doubt he will carry it forward to completion, with credit to himself and satisfaction to your honorable body as well as the Commissioners.

The first and second divisions now under contract, embrace a line of aqueduct of nearly twenty-one miles in length, and so soon as the Commissioners shall be placed in possession of the land, extending to the Harlaem River, and which has recently been adjudicated by the Appraisers, it is their intention, *should the means be provided*, to place so much of the third and fourth divisions under contract as shall carry the aqueduct over the river to the island of New-York, and probably to the receiving reservoir between 79th and 86th streets, and the 6th and 7th avenues. A work of this magnitude and importance, which is intended to last for ages, must not have its permanence and safety jeopardized by a too rapid execution of its parts; it is therefore necessary, in order that the operations should progress moderately, but steadily, that the whole line should be moving onward towards completion, at one and the same time. However desirable this has been to the Commissioners, they have, unfortunately, been prevented from carrying it into effect. The reasons have been so often alluded to and explained, that it would be useless to repeat them. The Commissioners are in hopes, however, that a better state of things is approaching, when the land owners will see that their interests have been consulted, both in the operations and conduct of the workmen, and in the measures pursued by the Commissioners.

The choice of materials, the form of the aqueduct and other appendages connected with the structure, are submitted by the Act of the Legislature, to the opinion and views of the Commissioners. In fixing upon the plan of the aqueduct, care has been taken, by proper calculations, to make it of sufficient capacity to convey, when required, the whole product of the river, or a quantity sufficient to give an ample supply for a population of one million of inhabitants. Considering also the necessity of permanence, solidity and durability in the work, means have been adopted to have the materials of the best and mostlasting kind, selected by competent judges, and tested by the most approved methods in use.

The foundation of the aqueduct is stone, upon which is laid a bed of concrete, composed of broken granite and hydraulic cement; the side walls are of hammered stone, laid up with cement; the floor is composed of an inverted arch of hard brick, eight inches thick; the lining of the side walls, and upper roof arch, are of the same thickness and materials, all laid with hydraulic lime mortar. No common mortar is permitted in the whole structure. The culverts and bridges are of dressed stone, of great strength, and suitable dimensions; all laid with hydraulic cement, which undergoes the usual tests before it is passed by the Engineer.

(To be continued.)

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## *Report of the Affairs and Prospects of the Canton Compauy of Baltimore.*

It affords me much pleasure in submitting this report, to assure you, that, although some events of the past year have occasioned much distress throughout the commercial world, and every where depressed the *market* value of all kinds of property; yet, in Maryland, others have been brought about that absolutely confirm, and will soon boldly develope the intrinsic value of the estate which this Company holds. On the city of Baltimore, within and adjoining which its property lies, the general difficulties, to which I alluded, pressed comparatively but lightly. Here very few even of the most enterprizing of our busy population, have been overtaken by insurmountable difficulties. The productive and commercial portions of our inhabitants have found their resources almost as much within their control, and as applicable to their ordinary operations as at any former period. But whilst the energies of individuals have been somewhat restrained, their engagements prudentially circumscribed, and their resources wisely husbanded; the public attention has been kept so steadily fixed upon the importance, expediency, nay, the absolute necessity, of constructing railroads and canals to connect this city with the North, the South, and the interminable West, that provision has been made by the States of Maryland and Virginia; the city of Baltimore, other municipalities, and individuals, to an extent so ample as to assure the final and early completion of Roads and Canals from Baltimore, on the one hand, to and through the States of Pennsylvania and New-York; and on the other hand, to and through the State of Virginia and other Southern States, and to the navigable waters of the Lakes and Great Western Valley, pursuing the cheapest, shortest and best routes, by which the commerce and travel of those immense regions can pass to or from the Atlantic.

The changes formerly wrought in the commerce and prospects of Baltimore by the employment of steam on the Western waters, and by the internal improvements made and being annually extended by the States of New York and Pennsylvania, on the one hand; and by Virginia and other states to the South—*conclusively demonstrated* that Rail Roads and Canals must be made to connect the city of Baltimore with the fertile and vast agricultural districts and incomparably rich mineral regions of the interior, to which by geographical position she is nearer than any other Atlantic city. It was obvious to all attentive observers, that she might hold a most profitable and unbounded intercourse, by such highways, not only with the portions of our country with which she formerly traded, but also with the boundless regions watered by the Mississippi and its tributaries; and those bordering on Lakes Erie, Michigan, Superior, &c.

Many of the wisest and best citizens of Maryland, early perceiving the necessity which commands the construction of the great works by which Baltimore must, if she would hold intercourse with the adjacent and interior States, happily encouraged, and timely prevailed with their compatriots, and with the governments of the United States, of the State of Maryland, and of the city of Baltimore, to undertake such works; and these have now been so far constructed as to assure their steady prosecution to early completion.

It may therefore truly be said, that the time has quite arrived when trade and travel may pass to and from Baltimore, by continuous Rail Roads and Canals through Pennsylvania and New-York, on the North; through Virginia and other States to the South; and also to the navigable waters of the Lakes and Western States.

That the commerce of Baltimore, now expanded and prosperous, its population great and rapidly increasing, its capital large and active, will be manifold increased, so soon as these magnificent works shall be brought into actual and extended use, no one can reasonably entertain a doubt.

And it may be as safely as justly averred, that the benefits of that increase of trade, numbers, and wealth will not only be experienced and enjoyed throughout the city of Baltimore, but will be largely and promptly felt and shared by the owners of property in its vicinity, in all directions; and especially by the owners of those portions which bind on or are near to its maritime margin.

That the commerce of Baltimore, soon after the canals and railroads herein alluded to, as about to be finished, shall in fact be used, will bring into request the whole water line of her port, and the ground convenient to the same, is morally certain.

The margins of the basin are already fully occupied, and the vessels engaged in our Bay and Coasting trade now crowd its wharves—and those of Fell's Point were formerly crowded by large vessels, to the use of which they are well adapted, and of which they can accommodate a very large number; but all these vessels would comprize but a small portion of the vast amount of tonnage, that will, ere long, crowd every part of our harbour.

To facilitate the trade that will arise in coal, lumber, lime, granite, and other bulky commodities, large areas, extensive water fronts, and *peculiar accommodations* will be found indispensably necessary.

That these causes about to come very soon into active and vigorous operation will thenceforth make Baltimore prosper more rapidly than she has at any former period, is perfectly certain. That this growth and prosperity will be without interruption, and keep even pace with the improvement of the vast and fertile country with which she is soon to enjoy unsurpassed facilities of intercourse; as well as with the developements of the incalculable deposits of the valuable minerals and metals, with which that country abounds, is likewise as certain as the flow of time.

Already the attention of capitalists and men of business from various parts of the Union and from Europe is anxiously directed to these places, with a view to make eligible locations, to form commercial, mining, and manufacturing associations; and to found the most useful institutions and extensive works. The property of this Company is daily becoming more and more the subject of inquiry. Men of forecast and capital have become anxious to acquire portions of its territory. Many applications have been made to purchase parts of it; but lots have latterly been sold only to accommodate some public works, or upon condition that they should be soon improved. Applications of this character have increased, and must rapidly multiply. It is the policy of the Company and the purpose of those to whom the management of its affairs have been confided, to favour such propositions, and to encourage by aiding those who propose to buy or lease and improve any of its lots: but the amount of the loans it may grant, to aid discreet and thrifty persons in making such improvements, will be always less than one-half the cost of the improvements, and be invariably returned at stated, short periods, and meanwhile constitute liens on lots so improved. And the annuities that will arise under leases, flowing as they will, from property eligibly situated, well improved, and annually growing in value, will rank with the best and most esteemed securities: and at all times be saleable, and thus form a resource ever expanding and indefinitely adding to the means by which the Company may encourage and aid others in making similar improvements on lots which it may sell or lease, in numbers rapidly increasing through a series of years. Yet such improvements, quickly as they may, and most probably will be made, must nevertheless proceed but progressively; hence it is deemed expedient to favour improvements on the grounds of the Company, especially on portions most remote from the water, with a view to their being occupied by industrious horticulturists, taking care however in locating buildings and opening avenues to fix all conformably to the general plan of the streets and avenues of the Canton grounds; and when granting the right to cultivate land adjacent to the lots on which such buildings may stand, also taking care to reserve the privilege to the company to determine such right, in whole or part, whenever it shall sell or lease such ground for any other than agricultural purposes.

If the expectations be just, which many of the best informed citizens of Baltimore, in common with myself, sincerely entertain as to the effects which the completion of the aforementioned magnificent works of internal improvement will immediately produce and annually expand; and if the plans contemplated and proposed to be carried forthwith into practice by those, to whose management the affairs of this Company have been confided, shall be steadily pursued—and as I do not doubt that those expectations will be more than realized and these plans be most happily consummated, I may venture to state, as I do without the least hesitation, that the estate of this Company is worth not only all which what it has cost, but its intrinsic value so far exceeds that cost or the sum of any appraisement which I would make, that I forbear to speak more specifically, merely from a sense of duty, which, whilst it commands me not to undervalue the property of the company, at the same time, forbids me to awaken any hope that might be even measurably disappointed.

And as it appears to me to be proper, I will as frankly state to you, that I believe appraisements of the property of the company should and may be hereafter made by disinterested persons, that by this means and the accounts of the receipts and expenses of the company, annual statements of its affairs may be made upon data so full and obviously just, as will warrant the declaration and payment of dividends that will approximate the rates of income, usually derived from capital actively employed, —whilst the estate of the company shall at the same time greatly increase in value.

The company now owns upwards of twenty eight hundred acres of land which begins at Fell's Point, within the city of Baltimore, and extends eastwardly, binding very nearly three miles on the water line of the harbor, commanding much of the front upon the deepest water of this port, and therefore peculiarly fit to accommodate merchant vessels of the largest class. This property, lying partly within the limits, and closely binding on the eastern side of the third city of this Union, whether we have regard to its population, enterprise, commerce or wealth, is so situated that circumstances stamp on it a value obviously great, and which must increase largely and inevitably from year to year. Its surface is so dry as to require nothing to be done to provide for the preservation of the health usually enjoyed in this moderate and salubrious climate; excepting only at two places, of very limited extent, which will be forthwith so modified as to justify the declaration that there cannot be found a more healthful location of equal extent in any port on the Atlantic coast. Upon almost every part of its area perfectly dry and firm foundations may be had, even at great depths. And the topography of these grounds is such as to require very little labor or expense to construct the wharves, or to open and grade the avenues or streets.

Minute and extensive surveys have been made by your General Agent, Caspar W. Wever, for the purpose of forming a correct connexion of the grounds of the company with the established streets of the city. This was found to be a work of much labour and requiring the patient and persevering exercise of great skill. Several of the boundary stones of the streets of the city were found to have been incorrectly located, and an application to the City Commissioners, therefore, became necessary to have them put in their proper positions. This was done; since then, the surveys have advanced as rapidly as circumstances would permit. A portion of the grounds has been laid out into streets and blocks, in conformity to the plan adopted by the committee appointed by the Board on Improvements and Contracts, and their positions have been defined by stones firmly planted at the intersections of those streets. The remainder will be similarly laid off and bounded, without delay; and then any and every part of the grounds of the company, will be in a condition to be disposed of, when, and as it shall be thought best. The paving of streets which had been commenced the previous year, has been completed, and several blocks of the ground are now ready for the reception of buildings.

A wharf, to supply the place of one begun in the preceding year, and which, when nearly completed, unfortunately fell, has been commenced and will be finished in the course of a few days. Its dimensions are six hundred feet in length by an average width of about fifty feet; and its position is south of and nearly parallel with Alice Anna street, and eastward from Washington street.

It will be expedient to finish the stone wharves immediately, that lie near to the east end of this new wharf, and also to prepare other and appropriate accommodations to despatch the business that will soon be transacted at such landing and on the company's grounds.

The improvements required on the small pieces of low ground that skirt a part of the margins of Harris' and Gorsuch's Creeks, to render these places herein before alluded to, as healthy as any other, will be made as soon as may be practicable.

The vast additions to the trade of this city which will be made on the opening of the great works of internal improvement now about to be completed, and which will far exceed any augmentation heretofore occasioned by kindred causes in any other state or country, will shortly require the construction of other suitable and extensive wharves, docks, and buildings, the plans for which will be timely devised and carefully executed.

Very important amendments were recently made to the charter of this Company, by one of which, its duration was extended to the first day of January in the year 1865, and its prospects never were so bright as at present.

The information and views embodied in the preceding report have been thus presented in accordance with the request made by the stockholders, assembled in general meeting on the 28th day of May last; and which request would have been sooner complied with, if it had not been deemed necessary that I should proceed to Pittsburg and Wheeling as a representative of the state of Maryland, in Canal and Railroad Companies, to assist in perfecting arrangements to complete the Baltimore and Ohio Rail Road to those cities, from which I have but just returned.

JAMES W. McCULLOH, President.

Office of the Canton Company of Baltimore,<br>26th day of June, 1838.

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## *Hudson and Berkshire Railroad.*

As this Railroad will be finished and in operation in the course of the ensuing sixty days, we think it not amiss to call public attention to it. It runs from the city of Hudson through Columbia county, to the town of West Stockbridge, in Berkshire county, Massachusetts, a distance of about thirty miles, and forms a link in the great chain of internal improvement which is intended to connect the most Eastern part of the state of Massachusetts with the Western part of the state of New York. This great chain of communication consists of a continuous line of railroads, commencing at Boston, and terminating on the Erie canal at Canajoharie. The counties through which they pass in this state are

Columbia, Green, Schoharie, and a part of Montgomery; and in Massachusetts through Middlesex, Worcester, Hampden and Berkshire.

The *Boston and Worcester Railroad*, which commences this line of roads, is already completed and in successful operation. Its length is about forty-five miles, and although costing $30,000 per mile, it pays a handsome profit to its stockholders.

The *Great Western Raiiroad* commences at Worcester, and passing through Springfield and other thriving towns in Massachusetts, a distance of 108 miles, terminates at West Stockbridge, where the Hudson and Berkshire road continues the communication to the Hudson river. The Western railroad has been rapidly building for a year past, and its grading will be finished a year from this next fall. To insure its final completion, the legislature of Massachusetts at their last session loaned to the company the credit of the state, to the amount of two millions one hundred thousand dollars.

The *Catskill and Canajoharie Railroad* runs from Catskill, a few miles below Hudson, (a communication between which will be carried on by a steam ferry constructed expressly for this purpose,) to the Erie canal at Canajoharie, with a collateral branch terminating in the Erie railroad in one of our Southwestern counties. The distance between Catskill and Canajoharie is seventy miles, and the road intersects the Utica railroad a short distance from the former place. Besides being under active construction during the last year, the Catskill road obtained a loan from the legislature last winter, which will enable its managers to finish the greater portion of it the present season.

What adds greatly to the value of these roads, as well as the Hudson and Berkshire, is the fact that they are all permitted to *carry freight*, which is not the case with the Utica road, and many others chartered by our state.

In regard to the Hudson and Berkshire railroad, the estimate of freight made in 1828, at the same time the estimates were made for the Worcester and Western roads, was, for the Worcester railroad, 27,000 tons; and for the Hudson and Berkshire road, 34,000 tons—a difference of 7000 tons in favour of the latter road. But even without this difference of tonnage, the amount of tolls received for freight alone during the past year, on the Worcester road, with all the disadvantages of the times, would pay ten per cent profit on the entire capital of the Hudson and Berkshire road. This arises from the great economy used in the construction of the latter road. As an evidence of it, we insert the cost per mile of several of our principal roads, to wit:—

| | | | | |
|---|---|---|---|---|
| The | Harlaem Railroad | cost near | $100,000 | per mile. |
| " | Mohawk and Hudson | " | 60,000 | " |
| " | Lowell | " | 55,000 | " |
| " | Stonington | " | 40,000 | " |
| " | Boston and Providence | " | 40,000 | " |
| " | Boston and Worcester | " | 30,000 | " |
| " | Utica | " | 21,000 | " |
| " | Hudson and Berkshire | " | 16,000 | " |

If the estimate of freight is correct, (and the articles of marble and iron alone already treble the amount then estimated,) it will, at one half the price now paid for tonnage by team waggons, pay a very large profit to its shareholders. In addition to freight, it is estimated that 30,000 passengers pass annually from Boston to the Hudson River, over the route this road travels; half of this number will at half the present price produce a farther revenue of near four per cent. upon its capital. The road also passes within a few miles of Lebanon Springs, where a line of omnibusses will be established to convey passengers in less than one hour's time.

That these advantages cannot be taken from the company by any rival road which may hereafter be established, it is proper to state that this company has exclusive possession of the only practicable pass that is to be found in the great chain of mountains, that, commencing at the Highlands, run through almost the entire eastern section of the state of New York. This pass is called *Canaan Gap*, and for much of the distance is only wide enough for one road.

The road has a gentle descent toward the river, nearly the whole distance; and as two-thirds of the heavy freight will pass from east to west, the transportation will be rendered easy, and a great saving made in engines and fuel. It is principally made of second growth chestnut timber, which, having been cut for better than a year, is perfectly seasoned and durable.

The scenery along the road, particularly through the village of Claverack, is unsurpassed by any in the state; and the immense marble quarries, from whence the Gerard College at Philadelphia, and a part of our new custom-house, are being built, together with the inexhaustible iron ore beds, from whence the West Point foundry obtains the greater portion of its iron, will be interesting objects to the traveller, and a source of great profit to the company.

When it is recollected that nearly all the eastern seaport towns, such as New Bedford, Nantucket, Salem, &c. &c., send up the North river for their flour, butter, cheese, potatoes, and other agricultural products, and that a large fleet of coasting vessels are constantly engaged in this business, it will be readily perceived that the tonnage on the railroads running from the east to Boston will be greatly increased over the present estimated amount. Already have several lines of canal boats agreed to descend the river to Hudson, to meet the eastern market contemplated at Hudson—which the eastern vessels will gladly avail themselves of, in consequence of the obstructions in the navigation of the river above the city of Hudson.—*N. Y. Commercial Advertiser.*

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From the Civil Engineer and Architects' Journal.

## *Brick and Cement Beam.*

Sir,—Observing an account in your last number of the brick and cement beams which have been lately constructed by Mr. Brunel, and by Col. Pasley, of the Royal Engineers, for ascertaining the strength of materials and their aptness for certain novel applications, I beg to mention an extraordinary example of the kind, which stands exposed by the way-side on the road leading from Vauxhall to Battersea Fields. Passing in that neighborhood a few days since, to ascertain the London Terminus of the Southampton Railway, I found an erection on a plot of ground, which that Company has selected for the purpose of a depot, exactly opposite the Cement Manufactury, Nine Elms, which is described by a board affixed, as an "Experimental Brick Beam."

This erection is a brick wall 24 feet 6 inches long, 4 feet 9 inches high, and 2 feet thick. Between its second and third courses from the bottom, two parallel lengths of slight iron hoops are inlaid, the ends of which are seen projecting; in the fourth course from the bottom, the hoop irons are again visible at each end; and above that, between courses seven and eight, there appears only a single length of the iron, in the next course after which there is none. The wall is raised six feet from the ground, each end resting on a pier of brick-work, *the length of twenty-one feet four inches clear between the piers being without support*, under which you may walk as under a wooden beam! This I consider a surprising proof of the strength of adhesion of Roman Cement: you will observe, that more than double the length of the brick-work in the experiments mentioned by Col. Pasley, is here unsupported. But this is not all; by a chain, or some other contrivance thrown over the wall at its centre, a cradle is suspended, loaded with pig-iron, and on which is inscribed the weight it contains, viz, 10 tons 14 cwt. 1 qr. 4 lbs.

If there had been the slightest elevation of the centre of this structure, forming any segment of a circle, or were there now any depression from the prodigious weight appended to it, there would be an evidence of settlement in the joints of the brick-work, or more probably of fracture in the bricks themselves; but this is not to be discerned; it is a perfectly horizontal brick beam, stretched, as it were, from pier to pier, over a space of twenty-one feet, supporting nearly eleven tons on its centre.

It is not for me to point out the practical advantages that may be derived from this curious experiment; I would recommend all scientific persons, to whom it is accessible, to see it, which they may do in riding past, and I should think the application of its principle, in a vast variety of instances, must suggest itself to them. Yours, &c. A. C. E.

Essex Street, November 17, 1837.

[This beam, loaded as described, has now been standing, to our knowledge, without any appearance of fracture, for nearly two years.—Editor.]

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(Continued from page 32.)

## *Minutes and Proceedings of the Institution of Civil Engineers, containing Abstracts of Papers, and of Conversation for the Sessions of* 1837.

March 7, 1837.

The President in the Chair.

### "On Experiments on the Strength of Materials. By Thomas Webster, M. A., Sec. Inst. C. E."

The object of this paper was to point out the importance, in making experiments on the strength of materials, of beginning with weights sufficiently small. In the series of experiments on the strength of various timbers, by Lieutenant Denison, laid before the last meeting of the Institution, the first weights are in some cases too large, for from the commencement the deflection increases more rapidly than the imposed weight.

The points to be ascertained in all experiments of this kind are, first, the weight which a beam can bear, the elasticity being unimpaired, or the Elastic Weight; and, secondly, the Breaking Weight. So long as the deflection increases in exact proportion with the increase of the weight, we may consider that the elasticity is unimpaired; but if the deflection increases in a higher ratio, that is, if the deflection for 1 cwt. be *one* inch, and for 2 cwt. more than *two* inches, we may suspect that some violence is done to the elastic force of the material. Thus a guide is furnished us in our observations; the weight before which this ratio is observed to change must be considered as the Elastic Weight. When a beam is to be broken, the effect of time should be noticed, and the increased deflection after a given number of seconds recorded.

The experiments of Lieutenant Denison bear out these remarks; for it will be seen, that the point at which he has noted the first permanent set, is, in very many cases, immediately after the change which is here laid down as the condition for determining the elastic weight.

With respect to the strength of materials, Mr. Cottam stated that it had often occurred to him, whether, if a beam be loaded by ever so small a quantity beyond the Elastic Weight, this beam would not in time be broken. This consideration might, he thought, explain some apparent difficulties, as when a beam breaks suddenly without any increase in the weight, but having been loaded to the same amount for many years.

Mr. Hawkins mentioned a case, in which a beam that deflected too much had been sawn down its middle and bolted up, so that its depth was increased in the centre from 10 to 11 inches. The effect of this was, that the deflection, instead of being about $1\frac{1}{2}$ inch, was only one-eighth of an inch. Was this great increase of strength to be attributed to the increase of depth simply, or to the lower half having become a truss and the upper a strut?

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March 14, 1837.

The President in the Chair.

The decay of timber in contact with stone was discussed, and several instances were mentioned in which the only decayed part of timber was that in contact with stone. This decay is entirely obviated by inserting the wood in an iron shoe, or by placing a thin piece of iron betwixt the wood and the stone. Several cases were mentioned in which the iron shoe had been found a complete protection against dry rot and decay; a hard crust is formed on the timber in contact with the iron, which seems effectually to preserve it. It was suggested that the system of grouting must contribute to the early decay of timber; bond timber had consequently been replaced by bond iron. Bond timber is used very generally at Manchester, and answers exceedingly well, but the high temperature of the buildings may be a preventive against the decay of the timber, as the walls are very soon dried.

The subject of the strength of materials was resumed from the last meeting, and especial reference was made to the experiments by Mr. Hodgkinson on the strength of iron girders, published in the Transactions of the Manchester Society. In this paper Mr. Hodgkinson supposes the forces of extension and compression to have a ratio 1 : n; and not that, within the elastic limit at least, this ratio is a ratio of equality.

Also, these experiments are directed especially to determining the form of beam which will be the strongest up to the instant of fracture; or in other words, the beam which will have the greatest breaking weight without any reference to the elastic weight.

These principles are contrary to those laid down by Tredgold, and to the opinions of many persons of great experience. Mr. Donkin and Mr. Francis Bramah maintained that within the elastic limit the forces of extension and compression are equal; that consequently within this limit the deflection will be the same, whether the beam is laid with a particular edge highest or lowest; that a beam, for instance, whose section is a triangle, will exhibit the same deflection within the elastic limit, whether the vertex or base of the triangle be laid uppermost; beyond this limit, however, the case is different.

The strength of a beam, according to Mr. Hodgkinson's experiments, depends on the bottom flanche; by increasing this he had made beams for which the breaking weights were 4000 the square inch of surface of section, whereas Tredgold's strongest forms were about 2500 the sq. inch.

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March 21, 1837.
The President in the Chair.

"On the strength of Iron Girders, by W. B. Bray, A. Inst. C. E."

In this paper the author states the rules which had been given by Galileo, Tredgold, and Hodgkinson, for calculating the strength of iron girders. He shows by a table that Galileo's rule must be utterly false when applied to girders having large bottom flanches. Applying this rule to two girders, one of them which contains double the metal of the other, they ought to be of the same strength, whereas Mr. Hodgkinson's rule makes the former only one-half as strong as the latter. Tredgold gives no rule for the case of a large bottom flanche. Thus there appears great inconsistency in these rules, and a formula applicable to all cases is still wanted.

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"On Mr. Hodgkinson's Experiments on Cast Iron Girders, by Thomas Webster, M. A.; Sec. Inst. C. E."

The object of this paper was to detail the result of an examination of the above experiments, undertaken with the view of ascertaining whether those forms of beams recommended by Mr. Hodgkinson as requiring greater breaking weight have also a greater elastic weight than the more ordinary forms, with equal flanches at the top and bottom. The principle assumed by Tredgold (which also was the principle assumed by Dr. Young) is, that within the elastic limit the forces of extension and compression are equal.

Mr. Hodgkinson's experiments must be viewed as directed entirely to determining the breaking weights, and the earlier weights are not set down in many of the experiments. The weights and deflections first recorded are in many cases very near the elastic weight and point of permanent set, so that there is great difficulty in applying the principle already laid down for determining the elastic weight. But in some of the experiments which have a long series of weights, it will be seen, on comparing the increase of deflection with the increase of weight, that this ratio changes from one of equality sooner in these forms than in those with equal flanches at the top and bottom. If then these beams with large bottom flanches do possess practical advantages, it may be from their allowing a violation of the elastic limit with comparative safety; this is a state of things, however, which ought never to be contemplated.

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April 4, 1837.
Bryan Donkin, Esq., V. P., in the Chair.

"Result of experiments made with a view to determine the best figure and position for wooden bearers, so as to combine lightness and strength; by James Horne, F. R. S.; A. Inst. C. E."

The results of several experiments on wooden bearers of different sections are tabulated; together with the dimensions and weights of the pieces, and the nature of the fracture. The conclusion at which Mr. Horne arrives is, that a triangular prism placed with its base upwards is the strongest figure and position; that with its edge uppermost the weakest for a given quantity of material.

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The subject of the vibrations produced in the soil by the passage of Locomotives and Coaches was discussed, and several instances were mentioned in which the vibration of the soil was sensible at the distance of a mile and a half during an observation by reflexion. It was stated that the experiments recently made for determining the effect which the passage of the locomotives at a small distance might have at the observations on the Royal Observatory had not been conclusive; but that as no sensible effect could be produced on any observation but by those of reflection, no apprehension of inconvenience was entertained.

It was also stated that a number of persons running down the hill in Greenwich park produces a slight tremor, which is quite sensible during an observation by reflexion, and that the shutting the outer gate of the Observatory throws an object completely out of the field of the telescope.

The comparative merits of the Single Pumping and of the Crank Engine for the purposes of raising water were discussed.

Mr. Simpson stated that it was a generally received opinion that a Single Pumping engine would do one-third more duty than a Crank engine: but that having recently had a Crank engine altered by Messrs. Maudsleys and Field, and fitted with expansion valves, it did the most duty. The two engines were worked from the same boiler. The duty of the Crank engine was about thirty-two millions; it works to a fixed lift, which is in some respects advantageous. The duty of the Cornish engines is reported at ninety-five millions, and an engine near London, in which the Cornish valves and system of clothing has been adopted, was doing a duty exceeding fifty millions.

With respect to the Cornish engines, it was stated that their superior duty is due to the system of clothing; that although many persons had examined their duty, the calculations appear to be made from the contents of the working barrel; that the Cornish bushel is 90 or 94lbs. of a very superior coal, the London bushel being only 80 or 84lbs.; that notwithstanding the great duty done by the pumping engines, the crank engines in Cornwall are doing less duty than the crank engines in London.

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"Notice concerning the Thames Tunnel. By Richard Beamish, M. Inst. C. E."

Several attempts have been made in former years to effect a communication between the opposite shores of the Thames by means of a Tunnel, all of which, however, failed. In 1798, Dodd proposed a Tunnel at Gravesend; and in 1804, Chapman projected one at Rotherhithe; and in 1807, Vazie commenced the construction of a shaft, 11 feet diameter, at a distance of 315 feet from the river. With Vazie was associated Trevethick, a man of great practical knowledge as a miner, and by indefatigable labour a drift-way 5 feet in height, 2 feet 6 inches in breadth at the top, and 3 feet at the bottom, was carried 1,046 feet under the river. In the spring of 1808, having first ascended from under a rocky stratum, though with a depth of at least 25 feet betwixt them and the bed of the river, the Thames broke in upon them, and not a single brick having been laid the work was irretrievably lost.

In 1823 the subject of a Tunnel was again agitated, and a company was formed to carry into execution the plans of Mr. Brunel. The first proceeding was to sink a shaft. One side of a wooden platform, or curb, was then laid on this shoulder, whilst the other side rested on an iron curb, having an edge below to which it was attached. Through this curb ascended forty-eight wrought iron bolts, 2 inches diameter, to the height of 40 feet, the height to which it was proposed to raise the shaft. The regular building of the tower on the curbs with bricks laid in cement was proceeded with, and yet farther bound together by twenty-six circular hoops of timber, half an inch thick, as the brick-work was wrought up. At the top of the tower was placed another curb, and the long iron bolts passing through it, having their ends formed into the screws, the whole was screwed solidly into one mass, and completed in three works. In a week after it was finished, sixteen of the piles having been driven, two by two opposite to each other, the whole structure was sunk half an inch, carrying down with it the remaining eight piles, on which it was brought to a rest uniformly and horizontally, thus permitting the sixteen piles to be abstracted by opening the ground at the back. The whole weight supported by these eight piles was about 910 tons (the weight of the shaft.) Having been left for three weeks to dry, and gravel having been heaped under the curb, the remaining eight piles were removed, two by two, till the mass rested on a bed of gravel. The machinery, viz., the thirty-horse high pressure steam engine, with gear for raising the excavated soil, was now fixed on the top. The miners were placed inside, and by excavating from around the bottom, the whole descended by its own gravity.

Mr. Beamish then describes the peculiar difficulties which were experienced previous to the first irruption.

The chasm in the bed of the river, formed by the irruption of 1827, was stopped by bags filled with clay, with hazel rods passed through them ; and the interstices filled by gravel. The irruption of 1828 was met by similar means, but the funds of the company not being then sufficient for proceeding with the work, the shield was blocked up with bricks and cement, and a wall four feet in thickness was built within the Tunnel.

For seven years the work was abandoned, till in 1835 a Treasury loan was granted, subject to the condition that the most dangerous part of the Tunnel should be executed first. On resuming the works, the first object was to provide a drain for the water from the shield, for which purpose two reservoirs were formed under the middle pier, from which drifts were formed to the bottom of the great excavation and shield. The water was abstracted from the shield at the lowest point, and the pipes of two pumps worked by the steam engine being brought into the reservoir, all the difficulty of the drainage was overcome.

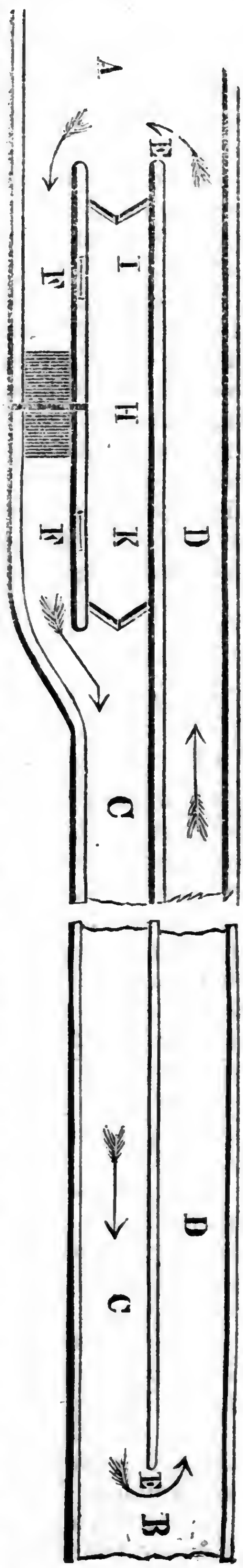
The removal of the old and the introduction of the new shield was a work of no ordinary difficulty. The bricks and cement had, by the strong oxide of iron which the water contains, been converted into a mass harder than most rocks; and not less than 1646 of surface, 342 of which constituted the ceiling, had to be supported on the removal of the brick-work previous to the introduction of the new shield. The means however adopted by Mr. Brunel, and which are described in the paper, were perfectly successful.

(To be continued.)

## *Improvements on Canals and the Motive Power thereon.*

At page 27 of our Journal, the reader will find among the patents there mentioned as having been granted between the 28th of September and 26th of October last, the following record :—" Henry Robinson Palmer, of Great George Street, Westminster, Civil Engineer, for ' Improvements in giving Motion to Barges and other Vessels on Canals ; 20th October." We are now enabled to lay before our readers some particulars of the method adopted by Mr. Palmer, and which forms the subject of his patent; these particulars we believe to be the first laid before the public.

Mr. Palmer, who, it is well known, has had extensive experience in canal and hydraulic works, has for a length of time devoted his particular attention to that complicated, and at present very imperfectly understood, *theory of rivers*, and has made a very extensive and important collection of experiments in various rivers and canals ; and from the discussion of these experiments, we sanguinely look forward to some additional light being thrown upon that difficult and important subject. It was, as we understand, during these investigations that Mr. Palmer contrived the canal improvements which form the subject of his patent, and of which we shall now attempt to give some idea ; but it must be understood, that the engraving attached to this article is not drawn to any proportion, but is a *sketch only*, to give a knowledge of the plan ; even the details of the arrangements may possibly undergo considerable alterations by Mr. Palmer, in carrying his plan out on a large scale.




Each pond of the canal, as AB, is divided into two parts or channels C, by a wall EE ; a third and short (or side) channel FF is also formed by another wall, in which two sluices I and K are inserted ; these sluices connect the short channel F with a lock formed by two pair of gates in the channel C ; at G, in the side channel, a *fen*-wheel, similar to an undershot water-wheel, or the paddle-wheel of a steam-vessel, is fixed, to which motion is communicated by steam or other fixed power ; the revolution of this wheel communicates motion to the water in the direction from F to C, and (as it will readily be perceived) in the direction of the arrows, through the whole length of the channel C, round the extremity E of the pond, along the channel D to the further extremity, and again beneath the wheel G, and then C, as before. By this simple, but admirable contrivance, the traffic can be conveyed in both directions, and to any extent whatever, by the same power, which, if steam be the power used, can also at the same time be employed in working the machinery of corn or saw-mills, &c., according to the demands of the neighbouring locality, and very advantageously, as the canal affords a ready means of conveying the raw material to the mill, and the subsequent produce to the distant market.

The introduction of the lock H in the channel C, appears to be the maintaining of the current in the direction of the arrows, as before stated, or the wheel would not produce the desired effect, it being necessary for the wheel to be kept out of the main channel C, that the motion of the traffic may be uninterrupted; the lock is to be so constructed, that a passing barge shall push the gates open before it for its passage; thus, suppose a large barge was passing from A towards B. it approaches the lock H with whatever impetus it may then have, the sluice I is opened by a lock-keeper, who may also have charge of the steam-engine; upon this sluice, or valve, being lifted, the water will pass from the lock, by the motion of the wheel, into the channel F and C, leaving the surface of the lock at a lower level than that of the channel D; and as the gates open inwards, the water, together with the impetus of the barge, will open them, and the barge will enter the lock, and the gates will again close; this done, the valve K is to be opened, which producing a current in the direction C, enables the barge to push open the second pair of gates, and so pass on in the direction of his route: the passage of these locks will delay the barges so little as not to be worth noticing.

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## *Extracts from the Specification of Samuel Hall's Patent for Improvements on Steam Engines.*

The objects of my invention (which invention I confine to steam engines worked by a vacuum produced by condensation) are to condense without injection water (for the purpose of creating as good a vacuum as is obtained and well known in injection engines,) the steam which passes through the engine for the working thereof, and also to condense for the most part (if not wholly) that portion of steam which usually escapes into the atmosphere through the safety-valves, when the pressure of the steam in the boiler is too high during the working of the engine, in order that the water resulting from the condensation of such steam, may be returned into the boiler. And also, further, to supply so much more distilled water to the boilers of the above mentioned description of engines, as is required to supply and replace any waste that may take place in the working thereof, in order to avoid the introduction of any water (into the boilers) containing saline or other extraneous matters.

My invention does not consist in the novelty of any of the five apparatus hereinafter mentioned, but in the combination of the whole five, or at least three out of the five, within proper proportions (as hereinafter described) as regards the first three, which I have found, by experience, to be beneficial, and from the want of knowing and observing which, I have reason to believe that all persons who have made former attempts of the same nature have failed. I now proceed to describe the above mentioned five apparatus, consisting of—

First, a sufficient quantity of metallic surfaces in the form of vessels, channels, passages, or pipes, of any convenient form, arrangement, or construction.

Secondly, a pump, or any other proper apparatus for the passing of a sufficient quantity of cold water amongst such above mentioned pipes, not only to condense all the steam of the steam engines, but also to cool the waters resulting from the condensation thereof, to as low a temperature as (or even lower than) that of the mixture of the condensed steam and injection water which is discharged from the air pumps of injection engines, in order to produce, by such application of cold water, when used in combination with the metallic surfaces, as above stated, and with the air pump hereinafter mentioned, as good a vacuum as is obtained and well known in such injection engines, if not indeed a still more perfect vacuum. The quantity of cold water which I employ is ten gallons for such condensation of such 60,000 cubic inches per minute.

Thirdly, the ordinary air pump of the capacity hereafter stated, to produce, when in connection with the before mentioned two apparatus, a sufficiently perfect vacuum, as above defined.

Fourthly, an apparatus for distilling water to replace the waste of water that may take place in the working of the engine, in order to avoid as above mentioned, the introduction of any water into the boilers, containing saline or other extraneous matters.

Fifthly, an apparatus, which I call the steam saver, for saving the steam that usually escapes into the atmosphere from the safety valves, when it becomes of too high pressure during the working of the engine, the apparatus causing such steam to pass into the condenser to be converted into water and returned to the boiler. It may be proper here to remark, that within certain limits, which experience will readily suggest, the above mentioned proportions of metallic surfaces, of cold water, and capacity of the air pump may be varied in a certain inverse order, that is to say, if the cold water be diminished, the extent of metallic surfaces, or the capacity of the air pump, or both should be increased. And, on the other hand, if the extent of metallic surfaces be diminished, the quantity of cold water, or the capacity of the air pump, or both, should be increased to produce the same effect.

Having now described the five several apparatus, the combination of which (within proper proportions, as herein before described, as regards the first three,) constitute my invention, I proceed again to define and explain the extent of my claims; I now therefore state, that I do not claim the exclusive use of any one of the five apparatus herein described, taken separately, some of them, if not all, having been used before; nor indeed, do I claim the use of any two of them, if unaccompanied by any or either of the others; but I do claim as my invention the exclusive use of the three-fold combination of the sufficient quantity of metallic surfaces, the sufficient buantity of cold water passing among them, and the sufficiently capacious air pump, as hereinbefore fully described, whether the said three-fold combination be used alone or combined with the distilling apparatus and steam saver, or or either of them: I also claim the exclusive right of combining the distilling apparatus and the steam saving apparatus, or either of them, with the above mentioned three fold combination, or even with the two first of them, *videlicet*, the metallic surfaces and cold water passing among them, should a less air pump be used. In witness whereof, &c.

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## *Antiquities of the Crimea.*

During the last year the workmen employed in making excavations in the environs of Kertch, made some important discoveries. Near the village of Glimsche two monuments were found, one of which appears to be seven centuries older than the other. The tomb, which is comparatively modern, contained a sarcophagus in marble, which was surrounded by valuable objects. Among them is a sort of altar-piece in marble, of a square form, and ornamented with a beautiful relief, representing a disciple of Bacchus, a silver sceptre, a gilt wooden bobbin-needle, the remains of a bridle, the bit of which is silver, and a woman's mask in gold, of the usual size, which was placed upon the body of the buried person. There were also several vases in bronze, silver, and gold; and to judge by the Greek letters inscribed upon one of the silver vases, it would appear that this sarcophagus was the sepulchre of the wife of a king Reskoreporls.—Several sovereigns of that name reigned at Panticapee. The other monument, which is of a much more ancient date, contained a sort of brick enclosure, in which was found a vase of clay, containing ashes and burnt bones. The vase is of a very elegant form, and is likely to excite attention from the beautiful drawings upon it. These are—an Amazon on horseback, attacking, lance in hand, two warriors on foot, one of which has a helmet, and the other a Phrygian cap On no other vase previously found in Taurida has there been seen any representation of a similar subject, and this circumstance adds to its value. The horse of the Amazon is white, although the rest of the drawing is red upon a black ground, and this variety of colors is very rare upon Greek vases The Amazon is not dressed in the costume usually given to female warriors by the artists who lived in the time of Pericles. The style of the drawing altogether gives rise to the supposition that it dates from the time of Penticapee, that is to say, the fourth or fifth century before Jesus Christ.—*Hayne Journal*

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## *New Invented Steam-Engine.*

At the British Alkali Works Stoke Prior, near Bromsgrove, a steam-engine has been invented by a laboring mechanic, and is daily in full operation, which will certainly supersede every other now in use, and that too, in a very short period of time; as the simplicity of its construction, the smallness of its size, and the almost nothingnesss of its cost, will necessarily bring it speedily into notice among all persons whose business may require the aid of so powerful an auxiliary. Its size is not more than twice that of a man's hat, and the expense of a five-horse power will not exceed in cost half a score pounds. Its form is cylindrical, being about eighteen inches in diameter, and twenty-two feet deep. The steam is admitted through a hole in a hollow circular belt (attached to a wall,) upon which it revolves, and works it by a diagonal action, against an upright piston, being forced out by pressure of a diagonal plate, which divides the interior into two portions. The rotary action is beautifully managed by means of a perfectly spherical steam-tight joint, at the end of a fixed inclined arm, towards which joint the upper and lower surfaces of the interior part of the cylinder are made to slope, after the form of the exterior of an hour-glass. Upon these the diagonal plate performs its revolutions, such movement being permitted through an opening (from the circumference to the centre,) equal in width to the thickness of the before-named upright piston, up and down the sides of which it continually works. To the centre of the bottom of the cylinder is fixed a shaft having attached to it a wheel which communicates the motion that may be required; and this is all the machinery of which it consists!!!

When, therefore, we consider the saving of weight of metal, size and expense, which will necessarily be gained by its adoption, and look at the incalculable advantages which such desiderata afford to steam navigation, our scientific friends will not consider us too bold in asserting that this invention will speedily revolutionize the whole system in this department of mechanics. Patents have been procured from every European government, and from the American; and no secret is made at the works in showing it to the public, either in action or in separate pieces, and in a model which is kept for the purpose.—*Civ. Eng. & Arch. Journal.*

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*Improvement in House Painting.*—A very simple method has lately been adopted to render the surface of paint perfectly smooth, and to entirely eradicate the brush marks; it is done by means of a small roller covered with cloth or felt, about eight inches long and two inches diameter, worked in an open frame on pivots, similar to the common garden roller. The flatting coat by this method is made beautifully even.—*Ib.*

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*Steam Navigation in Turkey.*

*Constantinople, 24th Nov.* 1837.

Comparatively speaking, until very recently, steam vessels remained almost unknown in this country, although its waters and peculiar currents are so well adapted to develope the advantages of steam power. Within a very short period, however, a considerable number of steamers now frequent this port, and they are constantly increasing. The French Government steam-packets are appointed to arrive here every ten days from Marseilles, touching at Leghorn, Civita Vecchia, Malta, Syra, and Smyrna, and returning by the same route. They ought to perform the voyage between Marseilles and Constantinople in 13 days, but as yet they have not been regular, and several accidents have happened.

The Trieste Lloyd s Commercial Company have established a line of steamers from that port to Constantinople, which are dispatched twice a month, touching at Arrocona, Corfu, Patras, and Athens, returning by the same route. Another Austrian company, established at Vienna, make Constantinople their head-quarters, and possess several fine steamers, one of which they run between this port and Galatz; another to and from Trebizond; another to and from Smyrna; and a fourth to and from Salonica. The Russians have a steamer between this and Odessa. At present there are only three English steam-vessels stationed here, viz., the Crescent, trading between Constantinople and Trebizond; the Essex, employed as a towing vessel on the Bosphorus; and the Levant, formerly on the Smyrna station, but now employed on any station that may offer. The Sultan does not at present possess a single steam-vessel, but jealous possibly of his vassal, the Viceroy of Egypt's fine frigate, the Nile, which was here some time ago, he is now building two large ones in the arsenal, for which the engines are ordered in England. Twelve months ago the Porte possessed two old steamers, sent out from England for sale on speculation three or four years previously, but as the Turks shockingly mismanaged and wore them out, the Sultan adopted a singular expedient of getting rid of them. He was graciously pleased to recommend (order) his Rayah, or Greek subjects, to form a company for steam navigation, to supersede the Ghiour, or Infidel companies; and in order that his subjects might commence operations without any delay, he liberally deprived his own navy of the only two steamers the government possessed, by selling them to his Greek subjects, himself fixing their price at 8,000*l.* for one, and 4,000*l.* for the other. In vain did the poor Greeks venture to urge that they knew nothing about steam-vessels, and did not wish to embark in such an undertaking; remonstrate they dare not, and they bowed to the Sultan's decision. The company was formed —the purchase money (fixed by the seller) was produced, and the steamers were made over to the company. The result was as quick as it was disastrous. The very first voyage attempted by the largest steamer to Smyrna she was run on shore, and her boiler burst in attempting to get her off. The smaller one was then dispatched to tow the other back to Constantinople, where she has remained ever since, perfectly useless. The next voyage attempted by the smaller steamer she was run on shore and totally lost at the Dardanelles, with much specie on board. The greatest difficulty which steam navigation in this country has to contend with, is procuring respectable and efficient engineers, so many of whom unfortunately give way to excessive drinking, or prove to be ignorant of their duties. Another drawback is, the almost impossibility of getting any serious accident to the machinery repaired here; but the oldest established Austrian company have wisely guarded against this, by having formed their own factory at Smyrna, where they repair or refit their vessels. The average price of coals laid down here from England is 40*s.* per ton. —*United Service Journal.*

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*Pittsburgh and Chambersburg Railroad.*—On Saturday last, a gentleman informed us that he had, a few days before, conversed with Mr. Hother Hage, the engineer employed in exploring and surveying for the route of a continuous railroad, from this city to Chambersburg, and that Mr. Hage stated that he had ascertained that a railroad could be taken over the Cove Mountain, at an elevation not exceeding fifty feet to the mile. Mr. Hage further stated, that by the route referred to, the length of the road from Bedford to Philadelphia would not exceed 227 miles.

That engineer is now employed in exploring the Alleghany mountain, and is expected to complete his exploration and know the result in the course of two or three weeks.—*Pittsburgh Gazette:*

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The Easton (Pa.) Argus announces the completion of the Lehigh navigation to the Great Falls. The distance is about twenty-five miles, in which a fall of six hundred feet is overcome by locks and dams, varying from fifteen to forty-five feet. The work was constructed and finished under the direction of Edward A. Douglass, Esq. the engineer of the company.

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*French Railroads.*—The Railroad Commission in Paris is making great progress in its labors. It has decided that the three lines to be first attended to, and to be executed by the Government, should be—1st, The line from Paris to Brussels; 2nd, From Paris to Orleans; and the 3rd, From Lyons to Marseilles. Besides these to be executed by the Government, it proposes that the road from Paris to Rouen, and the branch from Amiens to Calais and Boulogne, and from Basle to Strasbourg, should be executed by railroad companies, either now existing, or which may be created. All branches and isolated lines it also thinks most desirable to reserve for the execution of companies.—*Atlas.*

AMERICAN

# RAILROAD JOURNAL,

AND

# MECHANICS' MAGAZINE.

No. 3, Vol. I.] New Series.] | August 1, 1838. | [Whole No. 315. [Vol. VII.

## TO SUBSCRIBERS.

We desire it to be distinctly understood by those who are indebted for the Journal, for *past years*, that we cannot continue to send it to them, after the *Sixth* number of the present volume, unless *arrearages* and for the current year shall have been paid. We do not adopt this rule from choice, but from necessity, that we may not be compelled again to suspend its publication, in consequence of the expense of a large edition, of which many are not paid for.

It is true our *rule* has been to require pay in advance—yet, like many other rules, it has been deviated from to oblige subscribers at a distance, who could not conveniently send us so *small* an *amount*, until the publication was suspended. It is, however, now published again, and will be cheerfully sent to all who have *already*, or may *soon* pay for the current year and arrearages.

☞ Send any thing that will pass here—*even* ***Old United States Notes*** —at our risk.

## MECHANICS' MAGAZINE.

Subscribers to the *late* Mechanics' Magazine, formerly published at this office, who paid to a period later than *July one, Eighteen hundred and thirty-seven*, are requested to receive this publication instead, for a period equal to that paid for the Magazine, as the two works are now united and published *semi*-monthly. Numbers 1 and 2 were sent, last week, to such as had paid for the Magazine to a period subsequent to July 1, 1837; the following numbers will hereafter be sent regularly, unless we are directed to the contrary—and we trust that those who receive it will aid us in extending its circulation.

### *Remarks on De Pambour's Formula for Locomotive Engines.*

MESSRS. EDITORS,—In the first number of the new series of the Railroad Journal, I notice a letter from W. A. Talcott, Esq., to E. F. Johnson, Esq., Civil Engineer, containing remarks upon a tabular statement of the power of traction of Locomotive Engines, under different velocities, and a determined pressure of steam in the boiler, which was submitted by Mr. Johnson in a letter to the Directors of the New-York and Erie Railroad Company, and published in a former number of this Journal. This tabular statement Mr. Johnson computed from a formula furnished by De Pambour, and obtained results which Mr. Talcott shows to be contradictory, and charges it to the inaccuracy of the formula, declaring it to be "erroneous, giving results easily demonstrated to be false." To prove this assertion, he quotes an experiment made by De Pambour with the VESTA Engine, in which that Engine drew a load, including the tender, equal to 189 tons, on a level road, with a velocity of three miles per hour. To this Mr. Talcott applies De Pambour's formula for determining the load that an engine of a known limit of pressure will be able to draw at an assumed velocity, and obtains the monstrous result, that this engine, according to the formula, should have drawn 1061 tons! on a level road, at the given velocity; "thus showing a discrepancy in this instance between the result of the formula and experiment, of 872 tons."

It is evident that Mr. Talcott has misapplied the formula, which De Pambour has deduced with consummate skill, and verified by a series of carefully conducted experiments; for at the time of the above experiment, which was made in ascending an inclination of $\frac{1}{89}$, the engine was actually drawing its *maximum load*, with an effective pressure of 58 lbs. per square inch in the boiler, and the formula which De Pambour gives for ascertaining the maximum load of an engine, with a determined pressure, is

$M = \frac{(P - \rho)\, d^2 l}{(\delta + n)\, v} - \frac{F}{\delta + n}$ where—

M signifies the maximum load, tender included.
$P - \rho$ " the effective pressure of steam in the boiler per square inch.
$d$ " diameter of cylinder.
$l$ " length of stroke of piston.
F " friction of engine.
$\delta$ " resistance per ton of load, = 8 lbs.
$n$ " additional friction per ton of load = 1 lb.
D " diameter of driving wheel.

Applying this formula to the dimensions of the VESTA, and the pressure under which this engine performed the above experiment, we have $\frac{8352 \times 1 \cdot 145}{9 \times 5} - \frac{187}{9} = 191 \cdot 7$ tons: certainly a widely different result from that of Mr. Talcott's communication of 1061 tons! and which result corresponds very nearly to that of the actual experiment, which gave 189 tons; differing only $2\frac{3}{4}$ tons.

The velocity with which an engine can move its maximum load is determined by its effective evaporating power, multiplied by the ratio of the volume of steam, at the total pressure of the steam in the boiler, to the volume of water that produced it, and the diameter of the driving wheels,—divided by the square of the diameter of the piston, multiplied by the length of its stroke: $V = \frac{mSD}{d^2 l}$. Applying this formula to the VESTA, the evaporating power of which engine S is = 39·39 cubic feet per hour, and where *m* the ratio of the volume of steam at the total pressure at the time of the experiment, to the volume of water that produced it, was 414, diameter of driving wheel, 5 feet; stroke, 1·33 feet; and diameter of cylinder, ·9375 feet; we obtain a velocity of 71542 feet per hour—equal to 13·5 miles, per hour. The velocity of the engine may be reduced below this point, as was the case in the experiment with the Vesta, where the velocity was three miles per hour, and in Mr. Johnson's table, where he assumes 7½ miles per hour, but certainly *the load cannot be increased beyond its maximum.*

Mr. Johnson in his reply to Mr. Talcott's letter, frankly acknowledges that "too great haste" has betrayed him into erroneous results in his tabular statement; but instead of attributing this to the fact of having employed the formula, from which he computed his table, *beyond its proper limits*, he joins Mr. Talcott in viewing the formula incorrect in itself, saying that "the formula of De Pambour gives under a continued decrease of velocity a continued increase of power. and does not therefore designate the point at which it ceases to be applicable." We wonder at this remark of Mr. Johnson's, for De Pambour, after having established the formula which Messrs. Johnson and Talcott have used, says expressly:—"*We must, however, add, that in all cases for the motion to be possible, the resistance on teh piston must not be greater than the force that is to move it. Consequently, the resistance we have expressed by R must, at most, be equal to P. This observation fixes the limits of the possible load with a determined pressure. Beyond that point the equation may continue to give results, but they will no longer suit the question.*" Again, when treating the subject of the additional friction, De Pambour says—"*As soon as the pressure in the cylinder becomes equal to that in the boiler, there is no further diminution of velocity that will permit to increase the load; for an increase of load requires an increase of moving power, which is no longer possible.*"

Messrs. Johnson and Talcott have fallen into this very error: notwithstanding De Pambour's repeated and forcible caution, they have continued the equation beyond the point where P is equal to R, and have obtained results which no longer suit the question, but which they chose to ascribe, unhesitatingly, to the errors and inaccuracy of De Pambour.

Mr. Talcott further says, that "this is not an insulated case in De Pambour's experiments," but "that there is a great difference in almost every instance, between the experiments and the results of the formula." We will see how far this bold assertion of Mr. Talcott is true; and take, for instance, an experiment made on the same day as the above, with the same engine, the Vesta, which drew on the 16th August, 1834, a load, including the tender, equal to 71 tons, on a level road, with a velocity of 24 miles per hour; the state of the spring balance showing an effective pressure of 53·25 lbs. per square inch. Here, then, let us apply the censured formula, and see how *great* a difference will appear between the result thence deduced and the actual experiment: $M = \frac{mPSD - pd^2lV}{9VD} - \frac{F}{9}$.—

The letters here signify the same as above, and substituting the appropriate figures according to the dimensions of the engine, we have:—

$$\frac{(414 \times 9792 \times 39{\cdot}39 \times 5) - (2117 \times {\cdot}86 \times 1{\cdot}33 \times 126720)}{(9 \times 126720 \times 5)} - \frac{187}{9} = 66\text{tons}$$

Thus it appears that this formula which De Pambour deduced from the average results of numerous experiments with different engines, compared to the actual result of a given engine, yields a difference of only 5 tons. Certainly not sufficient to convince us of any incorrectness in the formula, as the remarks of Messrs. Johnson and Talcott would lead us to believe.

Mr. Johnson's table exhibits an engine weighing 13 tons, with 14 inch cylinder, 16 inch stroke, 4 feet 6 inch wheels, and 182 lbs. friction under a total pressure of steam in the boiler of 70 lbs. per square inch, drawing a load of 584 *tons!* Whence could this engine possibly attain such extraordinary power, being nearly double of what the best engines of similar dimensions, in this country, as well as in England, have hitherto been able to perform? And yet, Mr. Talcott, unhesitatingly, reasons upon this *impossible* result, and applying De Pambour's formula to it, finds a gross discrepancy, which is at once charged to a supposed error of De Pambour.

Let us, however, see what an engine of such proportions as Mr. Johnson assumed in his table is really able to perform, under a total pressure of 70 lbs. per square inch. Applying the formulæ, $M = \frac{(P-\rho)d^2l}{(\delta+n)D} - \frac{F}{\delta \times n}$ which we have shown above to be correct, we have $\frac{(7963{\cdot}2 \times 1{\cdot}166^2 \times 1{\cdot}333)}{9 \times 4{\cdot}5} - \frac{182}{9} = 336$ tons. Showing a difference between the maximum load that such an engine can move under a pressure of 70lbs. per square inch, and the result which Mr. Johnson presents in his table, of 248 tons! The result which we have obtained from the formula accords well with what engines of similar proportions have actually performed.

We will further take this result and apply the formula for determining the resistance on the pistons, which formula Mr. Talcott admits as nearly correct, and makes use of it to demonstrate the incorrectness of the other formula of De Pambour. $R = (F+\delta M+nM)\frac{D}{d^2l}+\rho$. Here $\rho$ signifies the atmospheric pressure, the other letters the same as above; substituting the appropriate figures we have $182+336+2688 \times \frac{54}{14^2 \times 16}+14{\cdot}7$ $=69{\cdot}9$ lbs. per square inch of surface of piston. Here, then, we have as the result of calculation according to the formula, a total resistance on the piston of 69·9 lbs. per unit of surface, while Mr. Johnson shows a total pressure of steam in the boiler of 70 lbs. per square inch. Surely here is no "great difference" between the result of the formulæ and that of the experiment, as Mr. Talcott would establish, but rather a close corroboration of theory by practice, as the most fastidious could require.

We will not pursue this subject any further at present, having, as we think sufficiently proved the general correctness of De Pambour's formula, which are rigorous deductions on well established principles of mechanics, from accurate and extensive experiments with engines of different construction, under various pressures, velocities and loads. And until Mr. Johnson demonstrates to us where De Pambour's "mode of conducting and analyzing his experiments" is improper or deficient, or Mr. Talcott "accomplishes more than has yet been effected by those who have heretofore written on the subject," we, with many others, must be permitted to admire the talent, industry, and care with which De Pambour has investigated, in the closet and on the road, this interesting and important subject, and highly to value the accurate formula which, for our convenience, he has so ably prepared.

I am, Gentlemen, your obedient servant,

C. E. Detmold.

*New-York, June* 15, 1833.

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## *Patent Process for Preserving Wood.*

We refer our readers to the advertisement on the cover, of Bill's Patent Process for Preserving Wood. This method, and particularly since it has been improved by H. B. Renwick, is well worthy the attention of Engineers and Builders. So far as we are able to judge, from the character of the material, the complete saturation of the longest pieces which has been effected, and the thorough seasoning which the wood undergoes in the course of the process, we are of opinion that wood thus prepared will be freed from all liability to the dry rot, and thoroughly protected from the attacks of the gribble worm ; nor is this opinion founded upon inference alone, for we have satisfactory evidence that wood prepared by Mr. Bill had been exposed for five years in the fungus pit at Woolwich, and for the same space of time in harbour, when the worm was very destructive, and when it was alternately covered and left dry at each flux and reflux of the tide. Its importance in almost every department of civil engineering, and of architecture, is therefore obvious, and there is hardly any species of structure, of which wood is the material, in which it cannot be used to advantage.

We are happy to learn that this process is already attracting much attention. The Navy Commissioners have directed some of the prepared wood to be exposed in the waters of the Dock Yard at Norfolk ; a Committee of the Board of Assistants of the Corporation of the City of New-York, has brought in a resolution to obtain a sufficient number of blocks prepared in this manner to cover a large extent of street; it has been favorably recommended to the Board of Directors of the Baltimore and Ohio Railroad, by their engineer.

For ourselves, we do not think it possible to speak in too strong terms of the benefit which may be derived from this process, in innumerable instances. The logs which are used in docking and building wharves may by it be thoroughly protected, and thus the continual injury to which our harbours are liable, may be prevented ; the dangerous effluvia which arise from masses of decaying timber, and which are a certain source of disease, may be prevented ; and the continual expense, arising from the necessity of renewal, obviated. In the paving of streets, the experiments made in our city have been most satisfactory in demonstrating the very great superiority of wooden blocks over all other materials, except in durability; by this process wood may be rendered as lasting as stone. We therefore hope that our Corporation will not rest satisfied with allowing the resolution introduced by the Street Committee of one of their Boards to rest on the table, but will carry it into effect. In railroads it will ensure a saving in the scantling, by rendering it unnecessary to take the diminution of strength by decay nto account, which will be equal to the whole cost of preparing the wood and purchasing the patent right, while it will make the cheapest and commonest wood equal, or even superior to locust.

We think that this process only needs the notice of Engineers to find favor with them. There are various uses to which such prepared timber can be applied, as in bridge building, or any other exposed situation for timber. We were particularly struck with its service as connected with Cram's Pile Driving Machine. We hope that this hint will be improved upon.

We annex a calculation relative to the cost of such timber for Railroads. —Sleepers for Railroads of the wood of the country through which the road passes, cost on an average about 30 cents; red cedar sleepers where they can be procured, cost 60 to 70 cents, say 60; the common sleepers last from four to six years, the red cedar eleven to thirteen; there are 1750 sleepers to the mile, and putting the different costs of the two kinds of sleepers at 30 cents, red cedar sleepers will cost $525 00 more per mile than the ones which will last say six years; it will cost from 12 to 18 cents to saturate the common sleeper, containing about two cubic feet, with coal tar, the cost depending upon the kind of wood and length of carriage of the materials for saturation, thus making—taking the maximum —the cost of tarred sleepers to exceed the cost of the common wood ones by $315 00 per mile, and they will last from thirty to forty years, if no longer, thus saving three or four removals of the whole materials, and taking up the whole road. The proprietors ask $200 per mile of single track for the right of using the patent; therefore, the saturated sleepers will still cost less than cedar ones, besides lasting longer, and the Railroad will, in addition have the right of making lasting, at a small expense, its wooden rails, bridges, and other timber work, within the mile for which the $200 is paid; as this payment gives the right of saturatng all the other timber used as well as the sleepers. There is also another advantage—that much lighter iron rails may be used, as the wooden ones when saturated may be trusted, as they will not rot, to bear some considerable portion of the weight of the cars,

### *North Carolina Manufactories.*

We copy the annexed article, in relation to the present and prospective Manufactures of North Carolina, from the Western Carolinian, published at Salisbury, N. C. From this it is evident that the right spirit is aroused among the people of North Carolina; and the inference may be fairly drawn, that the period is not distant, when the immense natural advantages for manufacturing possessed by North Carolina and Virginia, above tide-water, will be called into profitable use.

It must be evident to even the most casual observer who travels through those States—as one of the editors of this Journal had the pleasure of doing extensively in 1823 and '24—that they are eventually to become as noted for, as they have heretofore been for want of, extensive manufactories; as they possess, in the first place, inexhaustible and valuable minerals of various kinds, as well as a soil and climate for cotton, and then the necessary water-power, to *any amount*, for manufacturing purposes. It is now only necessary for the people of North Carolina to turn their attention, in the full confidence of success, to the construction of Railroads, as they are doing to a considerable extent, connecting the interior and western counties with the seaboard, and *the Great West*—to give an impulse to mannfacturing of various kinds, as well as to the improvement of their soil.

### *Cotton Manufactories in North Carolina.*

Since we became proprietors of the Carolinian, we have taken some pains to obtain all the information within our reach, concerning the Cotton Manufactories in North Carolina, knowing that it would prove interesting to our readers. Our list is not yet complete, but even as far us it goes, many of our citizens will be surprised to see the progress North Carolina has made in the establishment of Manufactories: it should be recollected that all these establishments, with the exception of two or three, have sprung up within the past three or four years. The following is, as far as we can ascertain,

A LIST OF THE COTTON FACTORIES IN ACTUAL OPERATION IN N. CAROLINA.

1. Factory at the Falls of Tar River, in Edgecomb County. This is the oldest in the State; owned by a Company.
2. Factory near Lincolnton, Lincoln County, built by a Company, but is now owned by Mr. John Hoke.
3. One at Fayetteville, owned by Mr. Mallet.
4. Another at Fayetteville, owned by Mr. Blackwell, and others.
5. One in Greensborough—steam power—owned by Mr. Humphreys.
6. One at Milton, owned by an incorporated Company.
7. One at Mocksville, Davie County, owned by Mr. Thomas McNeely.
8. One, or perhaps two, in Orange County, owned by Companies.
9. One at Salem, steam power, recently started, owned by a Company.
10. One in Randolph County, owned by a Company.

11. One at Lexington, Davidson County—steam power—if not already started, will be within a few days; owned by a Company.

Besides these, there are others now in the progress of building, and will soon be in operation.

LIST OF FACTORIES NOW BEING BUILT.

1. One at Rockfish, near Fayetteville, a fine water power, owned by a Company.
2. One near Rockingham, in Richmond County, water power, owned by a Company.
3. One on Deep River, near Ashborough, owned by a Company.
4. One near Leaksville, on Dan River, building of stone, owned by John M. Morehead, Esq.
5. One in Surry County, on Hunting Creek, owned by Mr. Douthet.
6. One on the Yadkin a few miles below Stokes' Ferry, in Montgomery County, owned by Mr. Edward Burrage & Co.
7. One on the South Yadkin River, 10 miles N. W. of Salisbury; owned by Messrs. Fisher & Lemly.

We understand that several wealthy individuals have purchased the Buckhorn Shoals below Haywood, in Chatham County, with a view of erecting a Cotton Factory,—but have not learned whether they have yet commenced operations.

It is also understood that an English gentleman has purchased Fullenwider's Iron Works, intending not only to enlarge the Iron Establishment, but to erect a Woollen Manufactory.

We also learn that there is a large Cotton Manufactory either in actual operation, or will be soon, in North Hampton County.

Beside these, it is very probable that there may be one or two others in the State, either in actual operation, or in the progress of erecting.

From these facts it will be seen that North Carolina is making rapid progress in Cotton Manufacturing; and we think the work has just commenced. Her facilities are so great that the business once started, must go on. We have water power abundant, and cheap. We have the raw material at hand, and what is remarkable, labor in the Western Counties of North Carolina, is cheaper than in New England.

The effects of the Establishments already in operation begin to be felt throughout the State: three years ago immense quantities of Cotton yarns were brought into the State by our Merchants from the North, and sold to our citizens—now, not a hank is brought—our own establishments not only supply our wants for home consumption, but are beginning to export the article. Parcels of North Carolina yarns have already been sent to market in the City of New-York, and find a ready sale at fair profits.—Even now, several of our establishments are making preparations to commence the weaving of coarse cottons. We may venture the opinion that in two years North Carolina will not only supply the demand for our own consumption, with the coarser cotton fabrics, but also send them out for sale into the markets of the world. On the whole, the Manufacturers of the Northern States need not much longer count North Carolina as one of their markets; they may rather regard her as a competitor, and one, who from the great advantages she possesses will soon become very formidable.

***Semi-Annual Report of the Water Commissioners, from the* 1st *of July to* 30*th December*, 1837, *inclusive.***

(Continued from page 55.)

A very important portion of the plan for supplying this city with pure and wholesome water, is the manner of bringing it over the Harlaem River. The mode in which this shall be performed has caused much serious reflection, both to the Chief Engineer as well as to the Commissioners. In the hope of obtaining some useful information on this subject, one of the Commissioners, accompanied by the Chief Engineer, repaired to Georgetown, in the District of Columbia, for the purpose of inspecting the piers already built, and the plan for building and sinking the coffer dams for those piers still to be built, for crossing the River Potomac, with the Alexandria and Chesapeake Canal. The difficulties experienced, in putting down and clearing the coffer dams of water and mud, were immense; first, in driving the piles of the dam, and securing them from the effects of floods and tides; filling in the puddling of clay, in the space between the outer and inner row of piles, so as to exclude the water from without: and in clearing the dam of water and mud. The pressure of the puddling, on the timber in the first dam sunk by Captain Trumbull, the principal Engineer on the work, was so great that, in several instances, the main parts of the dam, although composed of large white oak logs, broke asunder. This dam was cleared of water nine times in the course of about eight weeks, and was as often refilled by undiscovered leaks; supposed to proceed from the omission to drive the outer sheet piling down to the rock, and from fissures in the rock, under the mud bottom. Continual accidents were occurring with the gearing of the pumps, and other parts of the machinery; and, although the Engineer had made considerable improvement in sinking the subsequent dams, both in the pumping apparatus in use, and the means for preventing leaks; we nevertheless saw and heard enough to convince us that if, in crossing the Harlaem River, the sinking of such immense piers can be avoided, a vast amount of trouble and expense would be saved to the city

The Commissioners, in their report to your honourable body of 3d of July last, expressed a doubt whether it might not be necessary to apply to the Legislature for an additional and special act, authorizing the passage of the aqueduct over the Harlaem River; and that they had requested their Counsel, the Honourable D. B. Tallmadge, to examine the provision of the acts for supplying the city with pure and wholesome water; and to state whether, under those statutes the Commissioners are authorized to carry an aqueduct bridge over the Harlaem River, without further legislative authority. The opinion of Mr. Tallmadge was furnished the Commissioners on the 15th of July, twelve days after their semi-annual report was presented to your honorable body. He views the river, and land under it as belonging to to the people of this State. That the original act, of the 2d of May, 1834, contemplates the bringing of the water from beyond the Harlaem River, consequently crossing it; and the subsequent acts, of May 11th and May 25th, 1836, confirms this fact; and also that the Croton River was to be used for supplying this city with water,and must be brought over the Harlaem River by means of an aqueduct bridge or inverted syphon, as the Commissioners shall upon consideration determine. Taking these three acts together, with the cases cited relative to questions which arose in the construction of the Erie Canal, he is of opinion that no further legislation is necessary to authorize the Water Commissioners to erect a bridge for carrying the Croton Aqueduct across the Harlaem River." There are other important matters discussed, and legal opinions cited, in confirmation of this decision; for an elucidation of which we beg leave to refer to the opinion at length, a copy of which is hereunto annexed, marked B.

With a view of deciding the question, as to the best manner of bringing the Croton water across the Harlaem River, the Chief Engineer was instructed to furnish the Commissioners with an estimate of the cost of crossing said river by an aqueduct bridge on an inclined plane; and also by an inverted syphon, with iron pipes, on a low bridge. The following is a synopsis of so much of the report alluded to, as relates to the plan of construction, and some other matters connected with the subject.

It appears the width of the river on the high water level, was found to be 620 feet; and the distance across the valley of Harlaem River, from the grade of the aqueduct in the County of Westchester, to the grade of the same in the County of New-York, is 1,450 feet. The depth of the river, to the rock bottom, was found to be 32 feet below high water line, near the south shore; and only 20 feet, on the north shore.

The aqueduct bridge will have an elevation of 163 feet, above the rock at the bottom of the river, or an average of about 138 feet above tide. The span of the arches over the river must be 80 feet, and will regularly diminish to 50 feet span, for those to be built on the land. All the piers are to be constructed hollow, except those of 50 feet span, which are to be built up solid. The piers to be built of large stone, of uniform thickness in each course, and the joints not to exceed two and a half eighths of an inch. The work generally to be performed in the most approved manner practicable.

In making an estimate of the cost of this structure, the Chief Engineer observed, that he had been governed by the value of work of much similitude, estimated by several of the most competent men in the department of masonry; that there is no work under contract precisely similar, or of the same magnitude; or which from its elevation and inconvenience of access, will be so expensive in laying up, or requires so great a portion of large stone, or the same exactness of execution; at the same time, there is sufficient resemblance to constitute a guide; which with careful application, will not lead astray materially in computing the expense.

The estimate is given in the report in detail, and amounts in the aggregate as follows.

Estimate for a high bridge containing a uniform inclination of aqueduct . . . . . . . . . $935,745

The plan of carrying the water across Harlaem River by an inverted syphon, is next considered. It is proposed to erect a semi-circular arch, of 80 feet span, resting on abutment piers. The total height of the arch, from the level of flood tide, to the under side of it, will be 50 feet. This arch is placed on the New York side of the river, and will form a sufficient channel way for navigation.

From the north abutment of the arch, to the Westchester side of the river, will be constructed an embankment of stone, by casting them into the river until a sufficient bed shall be formed to support the foundation wall of the aqueduct. From the south abutment pier of the main arch, on the New York side of the river, an arcade of three arches, will be built; one of 35, one of 30, one of 25, feet span; and, connected with this, a foundation wall will be carried up the ascent, until it reaches the grade level, where the foundation and side walls are to be laid, to receive the pipes entering the effluent pipe chamber. The foundation walls, extending from the arcade of arches, and from the abutment of the channel arch, is to be formed of dry masonry; except two feet, constituting the face, and two feet across the top; to form the bed for the iron pipes; all of which to be laid in cement mortar.

A parapet wall will be laid on each side of the bed of the pipes, to support the earth covering; which is to be four feet deep, above the pipes, to protect the water from the effects of frost.

There will be an influent pipe chamber at the termination of the aqueduct on the north, or Westchester side of the river, in which the pipes are to be inserted. Commencing on this side of the river, at the influent pipe chamber, the pipes descend nearly with the slope of the hill, forming an angle near its base, and thence the lowest level; which determines the top of the foundation wall for the pipes, at four feet above flood tide. This level is continued to the angle, before rising to the channel arch; from whence an inclined plane carries the pipes to the effluent pipe chamber on the New York side of the river.

It is proposed to arrange the structure of the chambers, and foundation for the pipes, to accommodate four 36 inch cast iron conduits, whenever so many shall be required. Four *three feet pipes*, according to the calculation of the Engineers, will deliver 49,843,984 gallons of water every twenty-four hours; which is about the quantity calculated to be delivered by the aqueduct, and nearly the average quantity running in the Croton River. It is proposed, therefore, to insert only two of these pipes at present, they being deemed more than sufficient to supply the city with water for many years to come.

This estimate is reported in detail likewise, and amounts in the aggregate as follows:

| | |
|---|---|
| General Estimate for plan by inverted syphon and iron pipes . . . . . . . . . . . | $426,027 |

The following is a comparison between the two plans as to the estimated cost of both of them:—

| | |
|---|---|
| 1st. The High Bridge, maintaining its established inclination over the river . . . . . . . | $935,745 |
| 2d. Iron Pipes, supported by a low bridge . . . . | 426,027 |
| Excess of expenses for the high bridge . . . . | $509,718 |

In addition to the report of the Chief Engineer, the Commissioners directed a contracted plan of the two methods of crossing the Harlaem River, to be prepared by Charles B. Pearson, Esq., an architectural draftsman, now in the employ of the Commissioners, which are herewith submitted for the inspection of your honorable body; and, at the same time, for a more full and satisfactory elucidation of this important subject, they beg leave to refer to the able report of the Chief Engineer hereunto annexed, marked, C.

It will be seen that the Chief Engineer expresses a decided opinion in favor of the plan by inverted syphon or pipes; and the Board of Commissioners, after due deliberation, have adopted said plan, as, in their opinion far preferable to that for crossing by a high bridge and inclined plane.

The reasons which have governed the Commissioners in this decision are as follows:

1st. The difference in the cost of carrying an aqueduct over the river, on a bridge of 163 feet in height on seven immense stone piers, sunk in the water and mud, on an average of 25 feet below tide, with 80 feet span of arches, and that of conducting the water over a low bridge, requiring only one pier in the river, with an abutment, is sufficient of itself, in the opinion of the Commissioners, to decide the question.

2d. All the purposes and objects to be attained by the project, will as well be attained by the plan of a low bridge as by that of the high bridge, and at an expense of more than half a million of dollars less.

3d. The experience in sinking piers in so great a depth of water and mud, in order to reach the rock bottom, being very limited, and their great number and immense height, from the rock to the spring of the arches, although their construction is practicable, it must be attended with many unforseen difficulties and casualties ; and should the least variation from plum occur, or the least settlement on the foundation take place, it would carry with it very injurious results to the work; while with the low bridge and iron pipes, the same occurrence would be attended with but trifling injury, and could very soon be repaired.

4th. The water in a large aqueduct of masonry would, with much more uncertainty, be protected from frost on the high bridge, from the great elevated exposure and difficulty in surrounding it with a sufficient quantity of earth than when constructed on the land ; while the iron pipes, from their comparative size, may be bedded in earth of sufficient depth and compactness, to avoid all possibility of being affected by the frost.

5th. The effects of leakage has been found very injurious to the aqueduct bridges on our canals, and it is therefore a part of our contract to line the aqueduct, when the crossing of streams on bridges is necessary, with plates of cast iron, in order to avoid the possibility of repairs, which might require the shutting out of the water while effecting them, and thus be attended with serious consequences to the city. This evil will be entirely avoided by the use of iron pipes ; but should any thing occur to injure one of the pipes, the other would still be kept in operation, and conduct a sufficient supply of water through the aqueduct to the reservoir for all ordinary purposes.

6th. The time necessary to complete the high bridge would be considerably more than what would be required for constructing the low one, and a saving of time, in bringing to the city a sufficient supply of the Croton water, is a consideration worthy of attention.

7th. If the river should ever be made navigable, by the removal of the mills at Kingsbridge, and the obstruction of the dam at Macomb's Bridge, the facility afforded by the low bridge, of an archway of 80 feet in width, and 50 feet in height above full tide, will admit the passage of vessels of sufficient burthen and capacity, for every useful and necessary purpose, and the high bridge could do no more

Although the Commissioners have thus decided, based upon the foregoing reasons, and in accordance with what they deemed their duty ; they nevertheless admit, so far as architectural display is involved, that the high bridge has the preference; and if your honourable body should be of opinion, notwithstanding the great additional expense, that the aqueduct should cross the Harlaem River on a high bridge, and will fortify that opinion by an ordinance, passed by both Boards and approved by the Mayor, the aqueduct shall be constructed in accordance with the provision of such ordinance.

The necessary surveys and levels, to ascertain the most suitable course for the aqueduct on the island of New-York, has only recently been effected; some demonstration, however, towards completing a plan, had been made, under the direction of Major Douglass; but it was found necessary to go over the whole ground again, in order to arrive at a result satisfactory to the present Chief Engineer; and an earlier attention to the subject was prevented by the pressing necessity of preparing the first and second divisions of the aqueduct for contract; and also the great care required in a work of such magnitude and importance, that the first portions of the project should be well and permanently executed, as a guide and example for the future.

The result of these examinations carries the aqueduct from the Harlaem River to the receiving reservoir as follows: it commences on the New-York side of the river, at the effluent pipe chamber, on land belonging, or lately belonging, to the estate of Stephen Jumell, where a tunnel of 200 feet is contemplated. It then takes a southerly course, crossing the land of Mr. Watkins; then runs westerly on the land of Carman and Connor, and enters the 10th avenue at 151st street, where a tunnel averaging 45 feet below the surface, must be made from 140th to 135th street inclusive. The line then continues in the 10th avenue to 107th street, and makes a curve easterly to 104th street, and from thence runs parallel with, and 125 feet from the northerly line of the 9th avenue to 90th street, where another curve occurs, carrying the line to 85th street, where it enters the receiving reservoir. From this reservoir it is proposed to conduct the water through the 5th avenue to the distributing reservoir on Murray Hill, by iron pipes.

In following the line of aqueduct as above described, its grade will, in several places, be above the present surface of the ground, and from 102d to 95th street inclusive, in order to accommodate the carriageway and sidewalks, archways must be erected over the streets, and the aqueduct carried on a stone embankment of from 33 to 48 feet in height; and in passing through the 5th avenue with the iron pipes to the distributing reservoir, a portion of the carriageway must be graded, in order that the pipes may be sunk to a proper depth below the surface of the street, not to be out of the reach of repairs, should any be at any time required, nor so near the surface as to be exposed to the action of frost.

The Commissioners submitted an estimate to your honorable body in their report of the 3d of July last, of the probable cost of completing the first and second divisions of the aqueduct, and promised to report an estimate of the total amount that would be required to complete the whole project, including the receiving reservoir between the 6th and 7th avenues and 79th and 86th streets, and the distributing reservoir on Murray Hill, in order that authority might be obtained from the Legislature to raise the additional funds required. The Chief Engineer has, accordingly, at the request of the Commissioners, furnished them with his views on the subject, so far as they relate to the operations of his department of the works, including the most substantial and economical mode of construction, with the probable mode of such projected construction; and the Commissioners have added the actual cost of the land paid for, and the probable cost of that still to be acquired; also the sum paid for the temporary use of land for roads and embankments, and the probable expense of what may still be required, with other damages and probable charges for water and land, incident to the undertaking; also the amount already paid for salaries and other incidental expenses of the Commissioners already incurred, and including the amount that may be incurred; the estimates thus embracing every expenditure already made and to be made, from the commencement to the final completion of the work. In bringing together the several items which compose this estimate, an attempt has been made to cover every positive and probable expense, in the hope, at the same time, that the actual cost will be less than that stated; which the Commissioners will use every means in their power to effect, and thus a third application to the Legislature be avoided.

By a reference to the report of the Chief Engineer, alluded to above, it will be seen, that the crossing of the valley at Manhattanville, with the aqueduct, and the erection of the receiving and distributing reservoirs, are works of great magnitude and cost. For crossing the Manhattan Valley, three lines are designated, and an estimate furnished, for carrying the aqueduct on a high bridge from the north, to the south grade. The first line runs diagonally from 128th street, in the 9th avenue, to between 118th and 119th streets, in the 10th avenue. The second line crosses the valley and runs parallel with, and 125 feet from the 10th avenue. The third line continues through the centre of the 10th avenue.

The crossing of all these lines is to be effected by means of a bridge with semicircular arches of 50 feet span, similar to the diagram accompanying this report representing the high bridge over the Harlaem River.

The length of the three lines from grade on the north, to grade on the south side of the valley, are as follows:

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| First, or diagonal line . . . . . . . . | 3,300 feet. |
| Second, 125 feet east of 10th avenue . . . . . | 3,700 feet. |
| Third line, running through the 10th avenue . . | 3,700 feet. |

The maximum elevation of the bridge above the natural surface of the ground to grade line, is about 103 feet, and to the top of the parapet wall 116 feet. To erect a bridge on the first or diagonal line, as per estimate,

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| will cost . . . . . . . . . . . | $983,000 00 |
| The same for the second line . . . . . . | 1,286,880 00 |
| The same for the third line . . . . . . . | 1,286,020 00 |
| | $3,555,900 00 |

It thus appears that, making an average of the cost of crossing the valley on an arched bridge, by the three lines designated, and continuing the aqueduct on its regular inclination, will amount to $1,188,633.

An estimate is then presented, for crossing the valley with pipes, or inverted syphons of three feet diameter. The estimate proceeds upon the principle, that only two pipes will be required at present, which will supply about nineteen millions of gallons per day, and allow thirty gallons to each person, of a population of 600,000 inhabitants; and in order to show the economy of the plan of crossing the valley by pipes, instead of an aqueduct bridge, a sum or capital is added to the estimate, the interest of which will pay for any additional number of pipes that may, in future be required, from time to time, as the population increases, sufficient to carry the whole produce of the Croton River to the reservoirs.

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| The estimate for crossing with four pipes of 3 feet diameter, all laid amounts to . . . . . . . . . . | $453,670 |
| For two pipes of same dimensions . . . . . . | 303,926 |
| For five pipes, all laid down . . . . . . . | 550,988 |
| For only two pipes of the five laid down . . . . . | 346,372 |

It thus appears, if it should be deemed necessary to lay down four pipes in the first instance, at a cost of $453,670, which would furnish thirty-eight millions of gallons every twenty-four hours, there would still be a saving in the expense, by carrying the water over the valley by pipes, of $734,963, adopting the average cost of carrying it by an aqueduct bridge; and comparing the cost of building the bridge on the diagonal line, which is the cheapest, with the estimate for laying two pipes that will carry nineteen millions of gallons daily, there is still a saving by the latter plan of $679,074.

The Commissioners were in hopes, as they had abandoned the idea of crossing the Harlaem River with an aqueduct bridge, that they would have been enabled to recommend the building of a similar structure for carrying the water over the Manhattan Valley; a work that must have been an ornament to the city and a credit to the Corporation, as well as to the individuals having charge of its execution; but the vast difference in the cost, has put it entirely out of the question, and they have accordingly adopted the plan of carrying the water over the valley by pipes or inverted syphons.

In adopting the foregoing plans, for conducting the water over the Harlaem River, and in crossing the valley at Manhattanville, on the island of New-York, both the Commissioners and the Engineers have been governed by a wish to reduce the cost of the work to the lowest possible sum, consistent with its durability and permanence. The plan, however, may be modified, both in those particulars as well as others, if deemed expedient by your honorable body, and a high bridge may be substituted, instead of the syphon at the Harlaem River and Manhattanville, by incurring an additional expenditure of *one million, one hundred and eighty-eight thousand, seven hundred and ninety-two dollars;* and by delivering the water in the city, at a much less elevation than what has been contemplated, a lower grade may be adopted for the aqueduct, that wouldprevent its rising above the present surface on this Island. The Commissioners, however, do by no means recommend this deviation from the plan proposed; but as some of their fellow citizens have expressed a solicitude that the water might be carried on an aqueduct bridge with architectural display, the Commissioners are disposed to be guided by the opinion legally expressed by your honorable body on the subject.

That the permanent grade of the several streets and avenues, adjacent to the line of the aqueduct, ought, as far as practicable, be made to conform to such line, the Commissioners think must be admitted; and they trust, therefore, that the whole subject may be specially referred to a Joint Committee of both Boards and the Street Commissioner, with authority to take measures for opening and fixing the grade of such streets and avenues, through which the water is to pass; and to adopt such modifications of the plan, on the Island of New-York, as shall seem most conducive to the end in view; and the Commissioners and Chief Engineer promise to co-operate with such Committee, and to lend them all the assistance in their power.

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| The estimate for erecting the receiving reservoir, to have a depth of 20 to 25 feet of water, and to contain 158,000,000 gallons, is . . . . . . . | $310,500 00 |
| The distributing reservoir of Murray Hill, will have an average elevation of about 31 feet, above the natural surface, and 40 feet above the established grade, and will be 420 feet square. The estimated cost is . . . . | 295,340 00 |
| The total cost of the reservoirs . . . . . | $605,840 00 |

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| Amount brought forward, . . . . | $605,840 00 |
| The cost of the four divisions of the aqueduct, commencing at the Croton Reservoir, and ending at the receiving reservoir, including the crossing at the Harlaem River and the Manhattan Valley by pipes, amounts to . . | 6,189,000 00 |
| And for the connecting pipes, between the receiving and distributing reservoirs . . . . . . . | 499,110 00 |
| Add for contingencies and superintendence, eight per cent. | 583,516 00 |
| Total estimate for aqueduct, engineering, &c. . | $7,877,466 00 |
| To which must be added as follows: | |
| Cash paid for land in fee, and estimated to be paid . | 501,158 00 |
| Cash paid for temporary use of land, and estimated to be paid | 12,175 00 |
| Cash paid, and estimated to be paid, for salaries, postage, printing, travelling, stationery, Counsel and Chancery expenses, &c. . . . . . . . . . | 73,234 00 |
| Total cost of completing the works, except the iron pipes for conducting the water through the streets of the city | $8,464,033 00 |

It therefore appears that a sum of about $6,000,000 will be required for this object, in addition to the $2,500,000, authorized by the "Act to provide for supplying the City of New-York with pure and wholesome water."

For much interesting information on this subject, we beg leave to refer to the report of the Chief Engineer, hereunto annexed, marked D.

The foregoing estimates for engineering, salaries, and contingent expenses, are based upon the calculation, that the work will require five years from this date to complete it. Should a less time be consumed, however, the cost of the aforesaid charges will of course be proportionably less. The sum required is more than $3,000,000 over any of our former estimates, and can only be accounted for by the fact, that the Engineers, originally employed, did not possess the means of testing their calculations, by the actual cost of the work under contract, as we have been enabled to do. Your honorable body, however, were apprized of the fact, in our last report, that the "estimates of the Engineers, originally employed to make the necessary examinations, would fall far short, as the Commissioners have now good reason to think they will, of the sum necessary to bring the project to a successful termination;" and we added, "the Commissioners wish it to be understood, therefore, by your honorable body, as their settled opinion, based upon the result of the bids for that portion of the work offered for contract, and the very high price they have been compelled to pay for land and other privileges required for the works, that the total cost of the project will far exceed the estimates reported to the Common Council, founded upon data adopted by the Engineers in their reports dated the 1st of November, 1833, and 25th of January, 1835, and the 1st of February, 1835; all of which reports and estimates may be seen, by referring to the Documents of the Board of Aldermen, No. 36 of 1833, and No. 44 of 1835."

The Commissioners took the liberty, in their report of the 3d of July last, to suggest the propriety of appointing, by the Common Council, a Board of Commissioners, consisting of the Mayor, Comptroller, Counsel, Street Commissioner, and Chamberlain, to be denominated, *the Commis-*

*sioners of the Water Fund*, whose duties would consist, principally, in managing the fiscal concerns of the Water Loans, &c.; and for adjusting applications that may be made by the owners of land, or the contractors and others, for relief in cases not cognizable by the Water Commissioners, under the act. That another Board should be appointed, consisting of the before mentioned officers and the Water Commissioners jointly; and denominated the *Water Works Board*; and we cited the arrangement, by the Legislature of this State, in relation to similar matters, arising while building the canals, as an evidence of the utility of the measure; and we again beg leave respectfully to call the attention of the Common Council to the subject.

The Commissioners have thus stated, in detail, every transaction, of the least degree of interest, which has occurred since their semi-annual report, of the 3d of July last; and, consequently, this report has been extended far beyond the usual limits. The only apology they have to offer, for thus trespassing on your time, is, the construction they have given the provisions of the Act of the 5th of May, 1837, which appears to require a minute and detailed statement of every transaction of the Commissioners.

All which is respectfully submitted.

STEPHEN ALLEN,
WILLIAM W. FOX,
CHARLES DUSENBERRY,
SAUL ALLEY,
THOMAS T. WOODRUFF.
} *Water Commissioners.*

*Office of the Water Commissioners, January* 2, 1838.

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## *New York and Albany Railroad.*

At a meeting of the inhabitants of the counties of New York, Westchester, Putnam and Dutchess, held pursuant to previous notice, at White Plains, Westchester county, on the 7th day of July, 1838, Jonathan Aiken, Esq. of the county of Duchess, was appointed chairman, and J. W. Tompkins, of Westchester county, secretary.

After the meeting had been organized, Joseph E. Bloomfield, Esq., the commissioner of the road, was requested to communicate such information as he possessed, in relation to the surveys now progressing, and the prospects of the company, and stated that during the last session of the legislature, an act had been obtained, extending the time for the commencement of the construction of the road for two years from the 18th of April last. That on the 2d of May last, the company was regularly organized by the election of thirteen directors, and $750,000 of the stock (the amount required by the charter) subscribed. That immediately thereafter, he had proceeded to organize a corps of engineers, which had, since the 5th of May last, been continuing the survey of the line of the road from Milltown, in the county of Putnam, (where Joseph D. Allen, Esq., the engineer, in November, 1836, had terminated his survey) to Hillsdale, in the county of Columbia, 50½ miles. Mr. Bloomfield exhibited to the meeting the maps and profiles of the former as well as the last survey, and read to the meeting the following communication from Richard P. Morgan, Esq., the engineer having charge of the northern division of the line, as follows:

HILLSDALE, Columbia co., July 3d, 1838.

Joseph E. Bloomfield, Esq.:

DEAR SIR—I have proceeded with the surveys within four miles of this place, and have the pleasure of stating that the route has thus far fully equalled the expectations which have been entertained of it. We left off yesterday evening, 50 miles and a half from the point at which we began, which added to the distance on Mr. Allen's line, equals 102½ miles—the estimated distance from this place to Albany by Spencertown, is 40 miles —our route will be extended probably 6 miles—making the aggregate distance from Harlaem only 148½ miles. With respect to the several difficult points on our line, I have as yet found none requiring a grade over 30 feet to the mile; the general character of the route being level, or its equivalent. Our summit, which is in North East, is 752 feet above tide water. We are now gradually descending towards Hillsdale, and I flatter myself that I shall be able to intersect the *Hudson and Berkshire Railroad* in Ghent, without encountering any very serious obstacles. As you before intimated, I had better perhaps, from that point retrace my line, which though already good is susceptible of much improvement, and by making an approximate location, obtain the data necessary for an estimate of cost. I trust there will be found on this line facilities for cheap construction, as remarkable as the other striking advantages so far exhibited. I must not however omit to mention the favorable character also of our curvatures. In no case is it necessary to adopt a less radius than 2860 feet, and in general long strait lines can be selected, connected by very slight variation of direction or curvature scarcely perceptible. Very respectfully,

Your obedient servant, RICHARD P. MORGAN.

The commissioner further stated to the meeting, that from the surveys already made, the line of the road opposite Sharon, in Connecticut, was 494 feet above tide water, giving an average descent of about 5½ feet to a mile to tide water at Harlaem river. That 9-10ths of the line is level, or under 20 feet inclination to a mile, and the highest inclination is 35 feet at two points, and those for short distances of about one mile each.

Whereupon, Jonathan Aiken and Jonathan A. Taber, Esqrs., were called upon by the meeting to communicate such information as they had obtained, and the views of the friends of the road in the counties of Putnam and Duchess, and they stated that great anxiety was felt in those counties for immediate measures to insure the construction of this road. That they had lately held meetings in those counties, at which they had ascertained to their entire satisfaction, that the amount of stock required to construct the road through those counties would be subscribed immediately by the inhabitants in the vicinity, if the counties of NewYork and Westchester would subscribe the amount necessary to construct the road through Westchester, a distance of between 35 and 40 miles. That they had made full inquiries, and ascertained the probable amount of tonnage which would be transported upon the road when completed to Sharon, on the line of the state of Connecticut, a distance of less than 88 miles, at a cost of $1,000,000 taken from the amount now transported by land to the Hudson river, and at present prices, without any allowance for passengers, or increased transportation, the receipts of the road would equal 24 per cent gross income upon the cost, and after paying all expenses would afford a net income to the stockholders of ten per cent.

Governeur Morris, Esq., of the county of Westchester, was then called upon, with the other gentlemen present from the counties of Westchester and New York, to state to the meeting whether they could obtain in subscriptions sufficient to justify the construction of the road through the county of Westchester, and subscriptions to the amount of $200,000 were immediately tendered to be used in the construction of the road in said county, in four districts as hereinafter mentioned, of which $50 000 was offered by Governeur Morris, Esq., for himself, and $60,000 for his friends at Morrissania.

Charles Henry Hall, President of the company, being called upon, responded by taking in behalf of himself and friends to the extent of $300,000, to be expended in Westchester county, under the direction of the executive committee.

Ezra Hawley, Esq. of Catskill, on the behalf of the Catskill and Canajoharie railroad company, a prominent individual in aiding the construction of this important avenue to the west, attended the meeting, and stated that his company would continue their road to Hudson, and furnish every facility in conjunction with the Hudson and Berkshire railroad company to enable this company to intersect the last mentioned road, and thus form a continuous railroad communication from the far west to the city of New York.

On motion of Governeur Morris, Esq., it was resolved that this meeting recommend to the directors of the New York and Albany railroad company to prosecute immediately the survey of the line of the road from Harlaem river to Sharon, Ct., and that the present corps of engineers be increased, so as to have that line with the proposed alteration from Robbin's Mill to Newcastle, in the county of Westchester, completed by the 1st of September next.

That the line of said road be districted into nine districts, viz: 1st—From Harlaem river to Tuckeyho factory; 2—from last point to Robbins' mills; 3—from last point to Whitlockville; 4—from the last point to the Putnam county line at Owenville; 5—through the town of Southeast, Putnam county; 6—through the town of Paterson to Duchess county line; 7—through the town of Pawlings, Duchess county; 8—through the town of Dover, Duchess county; 9—through the town of Amenia to the state line opposite Sharon, Connecticut.

And that the directors appoint a resident agent in each district, with power to proceed immediately and obtain subscriptions for the stock from the inhabitants within each district, and negotiate with the owners of lands for the cession of the line of the road, of sufficient width to construct the same, and that each of said agents report weekly to the commissioner their proceedings.

On motion of J. W. Tompkins, it was further resolved, that in addition to the preceding powers to be conferred on said agents, it be recommended to the directors to empower said agents in obtaining the subscriptions for stock, to make the subscription conditional, to become absolute only when sufficient stock shall have been subscribed to cover the estimate by the engineer of the company, of the cost of constructing the road with a single track, and convenient turnouts from Harlaem river to Sharon, and that but 2½ per cent. on the stock be paid on subscribing, and the other 2½ per cent. on the 1st day of November next, and the residue by instalments of 5 or 10 per cent., as shall be required to meet the payments to the contractors in constructing the road; and that each of said agents be furnished with subscription books, and that all instalments paid on stock obtained on said books be paid to the agent in whose book such subscriptions are made, and by each retained and applied (except the first five per cent. required for expenses) in paying the contractors for the expenses of constructing the road through his district, under the direction of the executive committee of the company, and that the deficiency on any district be made up from the subscriptions received by the directors out of such districts, or the excess over expenses on other districts.

On motion of Jonathan Aiken, Esq. it was resolved, that the following persons be and are hereby recommended as suitable persons to be appointed such agents:

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| 1st district, | | Governeur Morris. |
| 2d | do. | J. W. Tompkins. |
| 3d | do. | Doct. Joshua Bowron. |
| 4th | do. | Isaac Hart Purdy, Esq. |
| 5th | do. | Hon. Ebenezer Foster. |
| 6th | do. | John Towner, Esq. |
| 7th | do. | Jona. Aiken. |
| 8th | do. | John M. Ketchum. |
| 9th | do. | Joseph D. Hunt. |

On motion of Col. Lewis Morris, resolved, that J. E. Bloomfield, Esq. correspond from time to time with each of said agents, and furnish them with the necessary subscription book, papers, and instructions, and condensed statements of the reports received by him from the several agents. —and that as soon as sufficient subscriptions are made to meet the expenses of constructing the road to Sharon, a meeting of all the directors and stockholders be called by him, at Somers, in the county of Westchester, to take measures for putting the whole line under contract.

On motion of Governeur Morris, Esq. resolved, that the directors be requested within sixty days from this date, to advertise and contract for the grading of the first section of the road from Harlæm river, 5 miles to the head of Mill creek, through which the lands required for the road are already given to the company, and that sufficient subscriptions to meet the expenses of the same, are now tendered and ready to be paid to the directors.

The president and a majority of the directors of the New York and Albany railroad company, being present at the meeting, agreed to adopt and carry into execution without delay, the preceding resolutions.

On motion of Jonathan A. Taber, Esq. of Duchess county, it was resolved, that the proceedings be published in the newspapers in the cities of New York and Albany, and in the counties of Westchester, Duchess and Columbia, and in such other papers as the chairman shall direct; whereupon the meeting adjourned.

JONATHAN AIKEN, Chairman.

J. W. TOMPKINS, Secretary.

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## *First Annual Report of the Directors of the Auburn and Rochester Rail Road, made to the Stockholders—June 4th,* 1838.

In making their Annual Report, the Directors of the Auburn and Rochester Rail Road Company, have the satisfaction of presenting to the stockholders, a favorable, though brief statement of the progress and prospects of the work.

The act incorporating this company, passed in May 1836, fixed its capital at two millions of dollars. The Commissioners found it difficult to obtain subscriptions of stock to that amount; and believing it unnecessarily large, they caused surveys and estimates to be made of the cost of the work. From the report of the engineer employed to make these calculations, it appeared that little more than one half the capital stated in the charter, would be required to construct the road, with a single track. An application was therefore made at the next session of the Legislature, and an amendment of the charter obtained, which authorised an organization of the company when one million and twenty-five thousand dollars should be subscribed. The books of subscription being again opened, this amount was promptly made up by citizens of the counties through which the road is located; and in March, 1837, the Stockholders held a meeting at Geneva for the choice of Directors.

Soon after their election, the directors organized their Board; and notwithstanding the unpropitious aspect of the times, they entered upon the discharge of their duties, by taking measures for an immediate examination and survey of the route. The increasing embarrassments of the times, enjoined great caution in the proceedings of the company; but they presented no serious difficulty in these preliminary steps; and in June they were commenced, and have been diligently prosecuted, under the direction of Mr. Robert Higham, an accomplished Engineer, whose industrious and efficient discharge of various and arduous duties thus far, has furnished the most satisfactory evidence that the Company were fortunate in his appointment to that responsible office.

With means in hand, the Directors did not permit the general embarrassments of the country, during the year past, to hinder this part of the undertaking: and it is believed as much has been effected, in surveying and locating the line, and in obtaining lands, as could have been accomplished under a better condition of business and money affairs. The experience, too, of similar companies elsewhere, has shown the impolicy of hastening these incipient steps; especially in a district of country like this, which presents a choice of lines, and where re-surveys often point out a saving in distance, and in the expenses of lands and construction. An examination of what has been done, will exemplify the advantages of great deliberation in first measures; and it is believed that no Company ever acquired accommodations on terms more favorable, nor met with a more enlightened liberality on the part of land holders.

At the last session of the Legislature, further amendments of the charter were obtained, simplifying the mode of appraisal of lands, &c., which will favor the operations of the Company.

The survey of the entire line for the road has been completed, and the road located, except that portion from the village of Auburn to the Cayuga Outlet, and through the village of Geneva, which has been deferred to give the stockholders residing at Geneva, an opportunity to express their opinions on the several proposed routes through their place.

The location from Auburn to the Cayuga Outlet has been postponed, with a view of procuring permission from the Cayuga Bridge Company, to cross within the limits embraced in their charter, which prevents any companies or persons from erecting bridges or establishing ferries within three miles, on either side of their bridge.

The importance of having the bridge over the Genesee river completed this season, in order to make the embankment for the depot in the city of Rochester, the earth of which will have to be carted from the cutting on the east side of the river, induced the Directors to have the masonry of the bridge progressing earlier than other parts of the work; and the Engineer was directed to receive proposals for the work. The proposals were received, the contract made, and the stone is now in course of delivery. To comply with the provision in the charter, requiring the work to be commenced within a certain time, the Directors caused the grading on one section of the road to be commenced, early in the season, which is still in progress.

The books of the Engineer show that he has disbursed since his appointment.

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| For Engineers, procuring titles to lands, &c. . . . | $13,027 00 |
| " Lands, . . . . . . . . . . . . | 5,868 82 |
| " Fencing . . . . . . . . . . . | 200 00 |
| " Damages to buildings, . . . . . . . . | 200 00 |
| " Grading, . . . . . . . . . . | 383 13 |
| " Printing, . . . . . . . . . . | 166 10 |
| " Office rent, stationery, meetings of Directors, and other incidental expenses, . . . . . . | 1,362 86 |
| Making a total of | $21,207 91 |

The total amount of lands required for the road, is five hundred and sixty-one acres, exclusive of village property and depots. Of this amount 329 acres are under contract for $16,476 00. The remainder, 232 acres, is estimated to cost $28,415 00, making a total for lands of $44,891 00, exclusive of village lots and depots. The ground for a depot in the city of Rochester, valued at $18,500, has been given to the company. At other places similar donations are offered, but as the depots are not definitely located, the offers have not been accepted.

At a meeting of the Directors, held at Auburn on the 9th of May 1838, it was determined to put the whole of the grading under contract; and the Engineer was directed to advertise for proposals. The proposals will be received until the third day of July, immediately after which the work will be commenced, and prosecuted steadily to a completion.

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Our own relative position acquires additional importance as we look at what is going on around us, and consider the effect upon our own interests, of measures projected in other states. The Auburn and Rochester Rail Road forms an important portion of an extensive line of communication, from east to west, through the great natural thoroughfare of business and travel, between the manufacturing districts of New England, and our own commercial mart, and the great agricultural country of the Lakes. From Boston to Buffalo, a distance of five hundred miles, connecting rail roads are in operation, or in progress of construction. The State of Massachusetts, whose sagacity long since discovered in the trade of the West, an object worthy contending for, has put forth an effort to secure an intercourse with that region, by subscribing two-thirds ($2,100,000) of the stock of the Western Railroad Company; whose work extends from the west termination of the Boston and Worcester Railroad to the line of our State, there to connect with the Stockbridge and Albany Company. Pennsylvania, in her efforts to divert the products of the growing west, and the fabrics of the east, from this natural channel, will thus find an emulous competition in Massachusetts: and if the stupendous works of the former excite our jealousy, the spirited measures of the latter should stimulate this, and other kindred Companies, to an energetic prosecution of their works, until the entire line of communication from the Atlantic to Lake Erie be complete. All which is respectfully submitted,

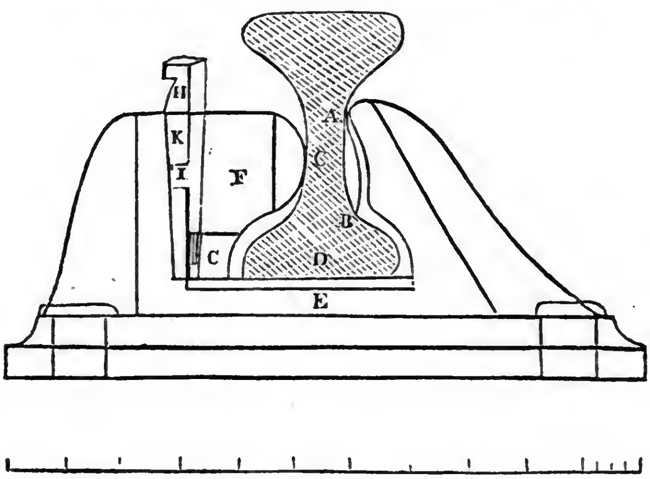
J. D. Bemis, *President.*

From the Civil Engineer and Architects' Journal.

## *Mr. Buck's Chairs for Parallel* **I** *Rails.*

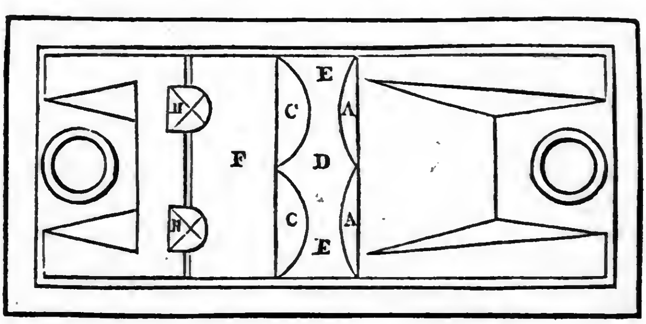
In the first place it is necessary to observe, that however strong a rail may be, a certain amount of deflection between the points of support must result from the gravity of the passing load; therefore, in order that no motion may be communicated to the chair (which is essential to the maintenance of the road in good order), the connexion between the rail and chair must be such as to allow of the libratory motion arising from deflection, the rail being nevertheless firmly fixed upon its seat, incapable of rising therefrom, and prevented from lateral movement; at the same time it should be free to move longitudinally as much as the expansion and contraction of its length from variation of temperature may demand. To attain these ends is the object of Mr. Buck's contrivance.

ELEVATION OF JOINT, OR DOUBLE CHAIR.




Scale of inches.

PLAN OF DOUBLE CHAIR, THE RAIL BEING OMITTED.




The above engravings contain a plan and elevation of a "joint, or double chair." The same letters refer to the same parts in both figures. In the elevation of the chair, the rail is sectionally represented in its place; in the plan it is omitted. The seat of the rail in the chair at D is convex, being $\frac{3}{16}$ of an inch higher than at E E; this form permits the libratory motion of the rail on its seat at or near D, but it is not peculiar to the chair I am now describing; it has been adopted in others, and is sometimes called "*cat-backed.*"

That side of the chair which is next to the flanges of the wheels has contact with the rail at only two points, A and B; these are blunt points, produced by the side of the chair being formed into spheroidal knobs; A is in contact with the vertical rib of the rail, and B with the superior part of the lower web, where a tangent to its curved surface forms an angle of 45 with the vertical. On the outer side of the chair the rail is confined to its place by a cast-iron "*chock*," or *filling-in piece*, F; that part of it next the rail is also made in a spheroidal form, and touches in a point only at C, about midway between A and B.

This chock has a step or foot G, resting on the seat of the chair, with a fillet I fitted into a corresponding groove in the chair, and the chock is wedged against the rail by means of the wrought-iron key H; this key is passed into a mortice, one-half of which is in the chock, and the other half in the chair, by which the key and chock are secured in their relative positions.

The mode of laying the rails in these chairs is as follows:—The blocks or sleepers, with the chairs affixed thereto, being previously laid in their places, the rails are dropped into the chairs (the width between A and K being sufficient for that purpose), and the chocks are then inserted horizontally, and wedged up by means of the keys H.

The effect produced by keying the chocks moderately tight against the rail at C, is to force the rail against the points A and B, and thereby, at the same time, down upon its seat at D, by the action of the point B, on the inclined surface of the rail in contact therewith. Now, it must be obvious, that so long as the key remains in its place, the rail is completely fixed laterally and vertically, and that it will be easily moved longitudinally, when contracted or expanded by difference of temperature: also, that the libration of the rail, occasioned by deflection, will produce only a very minute rubbing at the points A, B, and C.

A notch is made on the outer side of the head of each key for the purpose of extracting it by the application of a lever or pinch-bar.

The joint, or *double* chair, differs from the intermediate or *single* chair, only in being so much wider as to receive a double chock, with two knobs on it, each of which is keyed against the side of the end of one of the two rails which meet in the chair, the chock having two keys for that purpose. It may be objected that there is a chance of the keys getting loose, and jumping out of their mortices when a train may be passing at a high velocity; the most satisfactory answer to which is, that upon the London and Birmingham Railway, about four hundred yards in length have been laid by way of experiment with these chairs, over which the passenger trains have been running at velocities generally exceeding thirty miles an hour, without the least appearance of the keys working out; but, on the contrary, most of them have rusted fast into their places, and the points of contact have become smooth, and a little brightened by the libratory motion, which is an indication that these chairs fully answer the purpose intended.

In a rail weighing sixty-five pounds per yard, with four feet bearings, the space moved through at each deflection by that part of the rail which is in contact with the point C, is $\frac{3}{1000}$ of an inch.

These chairs are designed as a substitute for those now very generally adopted for similar rails, in which wood keys, or filling-in pieces, from 5 to 9 inches long, are used, and to which there are the following objections:—

*First.*—The keys, or filling-in pieces of wood, are liable to shrink in dry weather, and consequently to become loose and get out of their places.

*Second.*—Instead of keeping the rails down upon the seat, they lift them from it, and a blow is produced by the passing load forcing the rail down upon the seat of the chair.

*Third.*—In the joint chairs, one end of the key or filling-in piece is pressed down by the deflection of the rail, and at the same time the other end of it is elevated, whereby the butt-end of the contiguous rail, to which the wheel is advancing, is raised above the level of that upon which the wheel is at the instant pressing, and a shock is produced by the wheel coming into contact with the butt-end thus raised. This effect is produced when there is sufficient room in the chair for the play of the rail; but when the rail tightly fills the chair a rocking motion is communicated to the chair, and by the chair to the block, or sleeper, by which the road is rapidly put out of order.

*Fourth.*—The wood filling-in pieces will prove less durable than the cast-iron chocks, even supposing the wood to be Kyanized.

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## *Railway Chairs.*

Sir,—As Railway Engineering is now attracting a great portion of the public attention, perhaps the following simple suggestion may not be thought unworthy of the notice of those engaged in facilitating the operations of this popular branch of science. Yours, &c. C. L. O.

Experience having proved the importance of firmly fixing the rails into the chairs in all edge railways, and this operation being attended with some difficulty, the following plan is respectfully submitted to the consideration of engineers, &c.

Fig. 1.

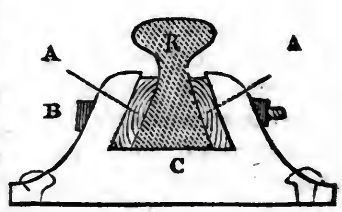


Fig. 2.

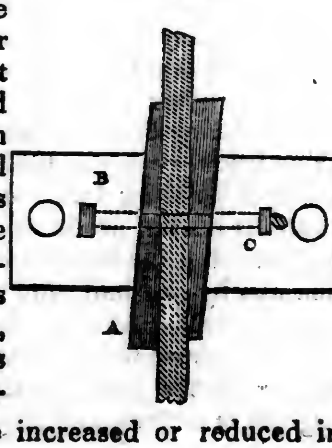


Fig. 1 represents the section, and Fig. 2 the plan, of an edge rail R, the flange of which is of a dovetailed form, with an opening in the chair C of a similar shape, only much larger; between the rail and the chair are two wedges A A of compressed oak, or other hard wood, drove in the reverse way to each other, as shown in the plan, Fig. 2. B is a screw-bolt, passing through both sides of the chair, through both wedges and rail, and screwed upon the other side of the chair, thereby preventing the sides of the chair from being forced too far apart by the wedges. The wedges might first be drove tolerably tight, and a hole bored through them carefully, to admit the bolt, which being screwed fast in, would compress the rail so effectually, as to entirely prevent looseness or shaking; the hole in the rail should be made larger than the bolt, to admit of its being accurately adjusted. By this method the rails might be adjusted with the greatest nicety, either to the right or left, in case the chairs were not very accurately fixed upon the sleepers, &c., as the wedges on either side could be increased or reduced in thickness as found requisite; the rails might likewise be slightly raised or lowered, by placing another small wedge underneath, either of wood or iron; and should the wedges at any time work loose, they might easily be replaced by fresh ones. Another advantage attending the adoption of this plan would be, that the wedges would yield slightly to the pressure caused by the expansion of the iron, and the whole might at any time be tightened by another turn of the screw-bolt; it must however be obvious, that the chairs must be of wrought-iron.

In the first instance, this plan might be attended with an increase of expense, but the advantages would, I think, greatly counterbalance it.

[In courtesy to our correspondent, we insert his letter and plan, which is ingenious, and have made such alterations as free it from those technical objections which would have otherwise been attached to it.—Ed.]—*Ib.*

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(Continued from page 66.)

## *Minutes and Proceedings of the Institution of Civil Engineers, containing Abstracts of Papers, and of Conversation for the Sessions of* 1837.

April 12, 1837.

The President in the Chair.

Mr. Brunel gave an account of the Thames Tunnel.—Having described the nature and difficulties of the undertaking, and the previous attempts which had been made by others to effect a similar work, he explained by reference to sections the nature of the strata below the river. He had adopted the rectangular form of the present excavation, because the work would set better than if of any other form, and had a better sustaining surface. The necessity of supporting the ground, and of having a sufficient shelter, had led to the adoption of the shield respecting which so much had been said. The construction of this would be understood by conceiving twelve books set side by side on their ends. These would represent the parallel frames which, standing side by side, but not in immediate contact, fill up the excavation. Each frame is divided into three boxes or cells, one above the other; the adjustment of the floors of which, and other details, were minutely described by Brunel.

Each frame is furnished with two large slings,by which it may derive support from or assist in supporting its neighbours; it has also two legs, and is advanced as it were by short steps, having for this purpose an articulation which may be compared to that of the human body. The frame rests on one leg, and then one side is hitched a little forward; then resting on the other leg, the other side is hitched a little, and so on. Hence the shield may be called an ambulating coffer-dam, going horizontally.

The brick-work was built in complete rings, and the advantages of this system of building had been fully proved by the fact of the two dreadful irruptions having produced no disruption. Such was the violence of the irruption, that the brick-work had in one part been suddenly reduced in thickness by one-half, and in one place there was a hole as if pierced by a cannon ball. At a few feet beneath them is a bed of quicksand 50 feet deep, and above them strata of most doubtful consistency, some of which goes to pieces immediately on being disturbed. Still, however, their progress is certain, and they only required patience to allow of the ground above them acquiring sufficient density. He found gravel with a mixture of chalk or clay extremely impervious to water; in some cases he contrived to let the water from the sand above them, and thus obtained ground of sufficient density. In their progress they were considerably annoyed by land springs, which produced cutaneous eruptions, and destroyed the finger nails of the workmen.

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April 18, 1837.

The President in the Chair.

Mr. Brunel gave further explanations respecting the Tunnel. He explained the way in which the ground above them had suddenly sunk down, owing to the run of a lower stratum of sand. This running sand which was a very great annoyance, consisted of *five* parts water and *one* sand. Bags of clay and gravel are not best where there are many stones; for the interstices do not become properly filled up; but in these cases the coarsest river sand is best; the water runs through at first, but soon stops; gravel and clay mixed are nearly impervious to water, but not so impervious as gravel and pounded chalk.

Mr. Gibb stated that he had found bags filled with clay and tow-waste exceedingly impervious to water. Being called upon to rebuild a sluice in a place where piling, owing to the stony nature of the ground, was impossible, he had formed a coffer-dam by laying down bags full of clay and tow-waste, in tiers of four, formed on the top of each other to the surface of the water.

The Ventilation of the Tunnel is effected by a pipe 15 inches square passing out under the fire-place of the steam-engine boiler.

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"Description of a proposed Levelling Machine. By John Harrison."

Mr. Harrison proposes to construct a machine which should make its own section of the country as it passes over it. This machine, of which the general appearance is like a caravan, is to be drawn on four wheels by horses, the machinery being moved by the wheels of the carriage. A section is generally made by marking on the base line the lengths; and on perpendiculars through these points the heights; and joining the points so marked off. But in this machine the section is to be made by the continued motion of a point acted on by two forces, one of which would carry it in a horizontal line uniformly with the space gone over by the machine, and the other vertically, according as the machine is rising or falling. The machine is thus divided into two distinct parts for effecting these purposes, and the way in which this may be practically effected is described in detail by reference to an isometrical drawing accompanying the paper.

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April 25, 1837.

The President in the Chair.

The paper by Mr. Beamish, which had been commenced at a previous meeting (April 2), was concluded.

Mr. Trubshaw presented to the Institution a model of the Centre employed by him in the construction of the Chester bridge.

The peculiar features of this Centre, which is described in detail in the first Volume of the Transactions, consist in the absence of horizontal timbers, the timbers being so arranged that their load is received end-ways, and in the lagging being supported over each rib by a pair of folding wedges.

Mr. Trubshaw entered into the details of the construction and method of striking the Centre, explanatory of the account contained in the Transactions.

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Mr. Macneill explained a method which he had recently adopted of laying down the sections of Railways so as to show at once to the eye the position of the cuttings and embankments; and a scale being laid upon the section, their heights and lengths are at once known, in the same way as by measurement on a detached section. This method will be understood by conceiving the line of railway traced on a map of the conntry, and a coloured part above to represent where a cutting has been made, and a differently coloured part below where an embankment has been made. The outlines of these will show at once the dimensions of the cuttings and embankments; in engraved plans, he should represent the cuttings by lines, and the embankments by dots, or stipling. The usual sections would of course be used by engineers, but a section similar to this would convey at once all the information requisite for committees. Two or more lines being projected in this way, the reasons for selecting one in preference to the others would, in many cases, appear at a single glance.

Mr. Macneill proposes also to adopt the terms acclivity and declivity, with a rate marked after them. Starting then from the metropolis, or some principal town, all the ascents would be acclivities, and the descents declivities. Thus all the information generally required would be conveyed by the inspection of a single section.

(To be continued.)

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## *Extract from the London Correspondence of the N. Y. Courier and Enquirer, of 9th June.*

Its remarks on the "seven foot system" for Railroads, are well worth the attention of our readers. As to the "UnitedStates *AsphaltumCompany*," referred to, which is formed for the purpose of "improving the ways of our principal cities," we are sure that it will find friends when it can be satisfactorily shown, that by its means the ways which its members pursue have been improved.

The subject of Atlantic steam navigation continues to attract universal attention here. Amongst the companies which have been formed is one called "The Atlantic Steam Navigation Company," which has purchased the large steam ship which was built at Liverpool last year by Sir John Tobin, purposely for the American trade. Ths vessel is equal in size to the British Queen, having engines of 500 horse power, and is intended to be fitted for sea in the course of a few weeks. At Bristol the greatest degree of enthusiasm prevails upon the subject, for at a meeting held at that city on the 7th instant, and which was attended by the mayor and all the principal merchants of the place, it was asserted by one of the speakers "That they had now laid a rail road of 3000 miles across the sea." The people of Bristol appear indeed to look upon the establishment of steam navigation to New York, as destined to revive the trade of their now for a long time declining port—connecting the arrival and departure of the ships with the facility of travelling by the Great Western Railway to London, upon the completion of the line. Considering, however, that Bristol has great disadvantages in the difficult access to the port—the oppressive port-charges, and its distance from the great northern manufacturing towns, it is more than probable that Liverpool will still retain the superiority as the grand port of embarkation from England to the United States. Of the Great Western Railway, twenty-four miles were opened from London on the 4th inst. The tracks of this line are on a new system, being seven feet wide, and the rails are laid upon sleepers of wood eighteen feet in length. The advantages of this change in the construction of railways have become very apparent since the opening of the great western line; for the power of the locomotive engine is greatly increased by the proximity of the load to the moving power, as caused, by the greater width of the track: nor is any doubt entertained that the saving in steam locomotive power will more than compensate for the outlay in the purchase of a greater width of land which is required for the construction of the line. The "seven feet system" as it is termed by Mr. Brunel, the engineer to the Company, is probably worthy of much attention in the United States, where the land required for the construction of railways is generally much less valuable than in this country, and where, consequently, much greater advantages would be gained by the economy of the steam locomotive power. The rails also on the great western and Southampton lines, are laid upon felt, for the purpose of procuring an elastic and easier motion of the carriage, which has for the present been perfectly achieved—though some engineers are of opinion that they will cease to be experienced after a short period of pressure by the engines and trains, and the consequent consolidation of the felt.

"A company has lately been formed in London, called the "United States Asphaltum Company," for the purpose of supplying the Mastic of Sessel to the United States. The Directors of the Company are parties of great respectability, and the shares are at a premium of 1¾ to 2 per cent. They assert that the pavements in the average of the American cities, cost not less than 3*s.* 6*d.* per foot, whilst the Asphaltic pavement can be laid down at 1*s.* 4*d.* per foot, and thence that great profits must result to the company from contracts which they propose to obtain for the paving of the cities in the United States. Undoubtedly this substance is valuable as a substitute for stone, for an experience of five years has proved it to be impervious to heat, cold, or rain, and to be not cheaper only, but ten times more durable as pavement for streets—roofing, as a substitute for tiles, slates or shingles—cement for hydraulic works, and numerons other uses to which it has been extensively applied in Paris and other cities in France. The Mastic of Sessel is procured from the district of Piedmont in Switzerland, and is a bituminous limestone of rare occurrence in geology—the product apparently of subterranean volcanic fire, by which the bitumen has been driven upwards through a stratum of limestone, into which it enters in the proportion of about 10 per cent. So perfect is the saturation of the limestone, that no artificial composition of mastic, comparable to the natural substance, has yet been accomplished by the numerous chemists who have lately been attempting its supercession both in England and France. The mining people in England and Scotland are attentively searching for a natural mastic in the various coal fields here, and probably a similar attention to the subject may be worthy of notice by the parties connected with the bituminous coal fields of Pennsylvania and the Western States. Should no natural Mastic be discovered in America, the company lately formed here will probably be a profitable one; for they have secured the exclusive right of supplying the Mastic of Sessel to every part of the United States, by which they will do "the state some service," if their representations be correct, that they can both have a sufficient profit from their operations, and reduce the rates for paving all the cities of the Union considerably more than half."

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## *Steamboat Accidents.*

We give the following extract of the late law on this subject from the New-York *American.* We are of the opinion that legislation, unaided by popular intelligence upon this subject, can do little or nothing—with such aid it can do every thing. We shall again advert to this subject.

*Synopsis of a law to provide for the better security of the lives of passengers on board steamboats or vessels.*

Sec. 1. Requires all vessels propelled in whole or in part by steam, to take out before the 1st Oct. next, a new license, subject to the conditions hereafter.

Sec. 2. Prohibits all vessels propelled as above, from transporting passengers or goods "in or upon the bays, lakes, rivers, or other navigable waters of the United States," after the 1st of Oct. without such new licence. Penalty for non-compliance five hundred dollars, for which a boat may be proceeded against summairly.

Sec. 3. Authorises the District Judge to appoint competent and faithful persons to inspect hulls, boilers, and machinery of every steam vessel, whenever requested so to do by the master or owner thereof, which inspectors are to furnish duplicate certificates of their inspection, and to take an oath faithfully to discharge their duty. No one to be appointed who is interested in the manufacture of steam engines or machinery.

Sec. 4. Requires the person appointed to *inspect the hull* of any steam boat, to state in his certificate the age of the boat, when and where built, and how long it has been running; and also whether the vessel is in his opinion sound and seaworthy. Fee $5. to be paid by owner or master.

Sec. 5. Imposes the same duties on the persons required to *inspect the boilers*—the certificates to state the age thereof, and whether sound and fit for use. One copy of the certificate to be delivered to the Collector, the other to "be posted up, and kept in some conspicuous part of the boat." Fee as above.

Sec. 6. The inspection under the 4th Sec. to be made *once a year*, that under the 5th Sec. *twice a year*—the certificate of such inspection to be delivered by the owner or master to the Collector, under the penalty of forfeiture of the licence, and incurring the penalties of running without a licence. A "competent number of experienced and skilful engineers" to be kept by the owners on board every boat—and for neglect of doing so, the owners and master liable "for all damages to the property or any passenger on board, occasioned by explosion or by derangement of the machinery."

Sec. 7. Requires under the penalty of $200, that whenever the boat stops for passengers, freight or fuel, the safety-valve shall be opened "so as to keep the steam down in the boiler as near as practicable to what it is when the boat is under headway."

Sec. 8. Requires under penalty of $300, boats navigating the lakes or the ocean, if not over 200 tons, to carry "two long-boats or yawls, each competent to carry at least twenty persons," larger steamers to carry at least three such yawls.

Sec. 9. Requires under like penalty all steamers referred to in Sec. 8. to carry with them an engine and suction-hose in good order, and to use iron rods or chains instead of tiller ropes.

Sec. 10. Requires steam vessels running between sunset and sunrise to carry lights—penalty $200.

Sec. 11. All penalties to be sued for in the District Court, where the offence occurs, or where the owner or master resides. One half for the informer, the other for the United States.

Sec. 12. "Every captain, engineer, pilot, or other person employed on board a steamboat," through whose "negligence, misconduct, and inattention," life is lost, shall be deemed "*guilty of manslaughter*," and upon conviction, be sentenced to confinement at hard labor for not more than ten years.

Sec. 13. In all actions against steamboat owners or masters, the "bursting of the boiler, collapse of a flue, or injurious escape of steam," shall be taken as "full prima facie evidence, sufficient to charge the defendent, or those in his employ, with negligence, until he shall show there was no negligence by him or those in his employment."

The Editor of the American properly remarks—" Here is legislation enough. It now remains with travellers and with juries to give it full effect, upon the first and every fitting occasion."

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## *Improvements in Steam Apparatus.*

An act authorizing the appointment of persons to test the usefulness of invention to improve and render safe the boilers of steam engines against explosions.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That the President of the United States be, and he hereby is, authorized to appoint three persons, one of whom at least shall be a man of experience and practical knowledge in the construction and use of the steam engine, and the others, by reason of their attainments and science, shall be competent judges of the usefulness of any invention designed to detect the causes of explosion in the boilers; which said persons shall jointly examine any inventions made for the purpose of detecting the cause and preventing the explosion of boilers, that shall be presented for their consideration; and if any one or more of such inventions or discoveries justify, in their judgment, the experiment, and the inventor desires that his invention shall be subjected to the test, then the said persons may proceed and order such preparations to be made, and such experiments to be tried as in their judgments, may be necessary to determine the character and usefulness of any such invention.

Sec. 2. *And be it further enacted*, That the said Board shall give notice of the time and place of their meeting to examine such inventions, and shall direct the preparations to be tried, at such place as they shall deem most suitable and convenient for the purpose; and shall make full report of their doings to Congress at their next session.

Sec. 3. *And be it further enacted*, That to carry into effect the foregoing objects, there be, and hereby is, appropriated out of any money in the Treasury not otherwise appropriated, the sum of six thousand dollars; and so much thereof as shall be necessary for the above purposes shall be subject to the order of the said board, and to defray such expenses as shall be incurred by their direction, including three hundred dollars to each, for his personal services and expenses: *Provided, however*, And their accounts shall be settled at the Treasury, in the same manner as those of other public agents.

Rh. M. Johnson,
Vice President of the United States and President of the Senate.
James K. Polk,
Speaker of the House of Representatives.

Approved, June 28, 1838.

M. Van Buren.

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*Eastern Rail Road.*—It is anticipated that the Eastern rail road will be in readiness to receive the cars in the course of three weeks. A considerable part of the rails are already laid down, and the whole supply of iron is received. We shall then be able to make the journey to Salem in the space of half an hour. Although the Eastern stage lines have for many years been distinguished for their rapidity and regularity, the journey between Salem and Boston will now be made in less than half the time of the shortest stage passage, and at a considerable reduction of price. We may therefore anticipate a more frequent and intimate intercourse between the residents of the two cities. *Boston D. Adv. July* 17.

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*Steam Ship Sirius.*—We see that a mistake concerning this vessel is going the rounds of the papers—and therefore have to correct it. The Sirius is not to be withdrawn for the present from the Atlantic. The vessel which is to ply as a packet between London and St. Petersburgh, though bearing the same name, is a new and beautiful *Iron Steamer*, finished in the spring purposely for that trade.

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*Milan, Dec.* 19.—Three railways are about to be constructed in this city, viz., to Como, to Monza, and Venice. That to Como will be commenced immediately, the Austrian Government having already granted a patent for it to M. Bruschetti and Volta, engineers of Milan. M. Bruschetti, well known in Italy as the author of two admirable works on the navigable canals and irrigation of Lombardy, the only books which contain a complete history of the progress of the arts of irrigation and internal navigation in that part of Europe, will shortly visit England for the purpose of examining the railways in that country, and of purchasing the rails and locomotive engines necessary for those proposed in the Austro-Italic States.—*Lon. Morning Post.*

# AMERICAN
# RAILROAD JOURNAL,
AND
# MECHANICS' MAGAZINE.

No. 4, Vol. I.] New Series.] AUGUST 15, 1838. [Whole No. 316 [Vol. VII.

For the Railroad Journal and Mechanics' Magazine.

*Remarks upon Sherwood's Magnetic Discoveries. By* ALEXANDER C. TWINING, Civil Engineer.

PUBLIC attention has been lately directed to the report of certain important discoveries in magnetism, made by Dr. Henry Hall Sherwood, and communicated by him to the Congress of the United States, at their last session. Dr. Sherwood's Memorial gave rise to a Legislative Report, offered by the Hon. Mr. Tallmadge, of the Senate, of which five thousand copies were printed, and which, of course, has been extensively circulated. This Report will be the subject of a few remarks, very obvious in themselves, but which seem to be called for by the prominent attitude in which the subject now stands before the scientific community.

Dr. Sherwood, in his Memorial to Congress, declares himself to be the inventor of a method of ascertaining *the latitude and longitude of any place* (as well as certain other valuable elements of knowledge), and this either at sea or on the land, and in all weathers, without a celestial observation, but *by the dip of the needle merely.* He professes to have composed extensive tables to facilitate the calculations of latitude and longitude, variation of the compass, &c. from the dip, and has offered his discovery to the severe test of actual trial. In pursuance of this offer, we are informed in the documents accompanying this Report, that numerous trials were in fact publicly made, and that the results have always verified the theory. Indeed, the documents themselves embody the results of several such trials, in which Dr. Sherwood is said to have computed, from the dip or the variation, the longitudes and latitudes of Washington, New-York, St. Louis, Valparaiso, and other places; and, in every instance, the results, as there set forth, exhibit an accordance with those of astronomical observation, which leaves little to be desired on the score of accuracy and nice agreement. To make the whole more imposing, and give evidence of the correctness and high practical value of Dr. Sherwood's discoveries, testimony of another kind from men of high respectability and talent is also introduced into the documents alluded to.

Now the first remark which seems to be called for, in relation to the foregoing statements, is this—that the very proposal of Dr. Sherwood carries an absurdity on its face, and one that may be made so plain to every man in the least acquainted with these subjects, as not to admit of question. The inventor proposes, by means of the dip merely, (provided he is also furnished with the time when that dip was observed) to determine the latitude and longitude of the place of observation. But the truth is, that for every assignable dip, except that of 90°, where the needle is perpendicular to the horizon—there exists an indefinite number of places on the globe at which that same dip obtains. At any place whatever, except the magnetic poles themselves, if you permit the dipping needle to take its position, it is possible, by going either easterly or westerly, to take a line all round the globe and back to the point of starting, through the whole of which the needle shall maintain its dip unvaried. The proposal therefore is nothing less than this—to determine specifically that which is in its own nature incapable of determination by the means proposed. To attempt finding the latitude and longitude of a place by the *dip merely*, is a problem as indeterminate as it would be to find the unknown sides and angles of a triangle from but one side and one angle given.

I do not deny that it may become possible, at a future day, when the laws which govern terrestrial magnetism shall have been fully developed, to determine, with greater or less precision, the latitude, longitude, dip, or variation at a given place and time, by having *any two* of the above named elements given,—for example, by the dip and variation both given, to find latitude and longitude; or, by the dip and latitude both given, to find longitude and variation, &c. &c. I have looked carefully to ascertain whether injustice has not been done to the author of the invention in question by a loose statement of the means he proposes to employ for his object; and whether, in fact, more elements have not been used in his computations than had been unguardedly stated. But I have found no indication to this effect. The language is uniform, in the original memorial, in the legislative report, in the expositions of the theory which accompany the report, and most of all, in the examples there given to exhibit the actual processes. In all it is the dip merely, or the variation merely, which is given in connection only with the time of the observation, and the magnetic hemisphere in which it was taken.

But, even if there were room left to suspect an oversight of the kind suggested, there is a second circumstance which, equally with the first, goes to subvert the whole professed discovery. It is this—that the pretended results of Dr. Sherwood's computations, as given in the Congressional documents, although exhibiting an apparent consistency with facts already known, are nevertheless utterly at variance with the *legitimate* results of the very theory from which they purport to be derived. There is no need of new and voluminous tables to compute the results of Dr. Sherwood's hypothesis, they being all within the compass of simple spherical geometry. That hypothesis, as set forth in the memorial and documents heretofore alluded to, simply propounds as follows: that the earth has two magnetic poles, an arctic and an antarctic, situated in the polar circles, at points diametrically opposite, and completing a revolution westward in those circles once in 666 years, very nearly, or at the rate of 32′ 26″ annually; that the longitude of the arctic magnetic pole, on the 15th of September, 1837, was 93° 16′ 03″ west; that the meridian of no variation had also then a position which the theory assigns; that the magnetic equator is a great circle of the earth perpendicular to the magnetic axis, and makes of course an angle of 23° 28′ with the terrestrial equator; and finally, that the dip of the needle is always equal to its distance from the magnetic equator, that is, to the magnetic latitude.

With the foregoing elements, then, for my guide, I turn to page 16 of the documents, and select for verification the example No. 9 there given; being the "Latitude of Washington, from dip observed by Lieut. Wilkes, June 26, 1838. Dip=71° 13′ 30″." In this example the latitude, as computed by the author of the hypothesis, came out with a variation of only about two minutes and a half from the truth; and even this small difference was explained by Dr. Sherwood to be due to a slight error of the observed dip, caused by an imperfection of form in the dipping needle used, and which was pointed out to Lieut. Wilkes by Dr. S. before commencing the computation. Now the latitude of Washington is given at 38° 52′ 44″; and supposing a spherical triangle constituted between the place named, the terrestrial pole and the magnetic pole, we have the three sides of the triangle as follows:—

*First*, the distance of the two poles, . . . = 23° 28′ 00″
*Second*, the north polar distance of Washington, being the complement of the latitude . . . = 51 07 16
*Third*, the magnetic polar distance of Washington, being the complement of the dip . . . = 18 46 30

This is the triangle which the hypothesis supposes, and a glance will show it to be one whose two smaller sides are together less than its third side, and which involves, therefore, an obvious absurdity. The fact is, that the greatest dip which, according to Dr. Sherwood's theory, could ever obtain at Washington at any period of the magnetic revolution, would be 62° 20′ 44″, or about nine degrees less than the true dip, as observed by Lieut. Wilkes. So much for example No. 9.

I next select example No. 4, on page 14. In this instance the testimony is, that the dip was furnished without naming the place of observation; and the demonstration of the hypothesis consists in the alleged fact, that Dr. Sherwood wrought out the latitude and longitude correctly, and thereby discovered the true place, from the dip alone. It proved to be a dip that was taken by Basil Hall, at Guyaquil. This dip is stated at 12° 11′ 30″, and was given to Dr. Sherwood only with the accompaniments of its having been taken in the year 1821, and "west of the line of no variation and south of the equator;" it being necessary for the computer to know (see page 11) "if the dip be given, whether the place of observation is east or west of the circle of no variation; and if the variation be given, whether it is north or south of the magnetic equator." From the terms enunciated—no denomination being given to the dip as north or south—one would suppose it *south;* it having been taken "south of the equator"—meaning the magnetic equator. On this supposition, if we constitute a triangle whose sides shall be—the north polar distance of Guyaquil, the arctic magnetic polar distance of the same, and the distance of the two poles,(23° 28′) and compute the longitude of the place of observation, the result is, that Capt. Hall must have mistaken his longitude by an entire hemisphere, and have been really in the central wilds of Africa instead of being, where he thought, upon the western seaboard of South America. In relation, however, to this truly wonderful result of the hypothesis in question, perfect fairness may, perhaps, require us to admit a probability that the word "*south*," in the enunciation, ought to have been printed "*north*," in which case the error of longitude would appear more moderate, not transferring the real place of observation more than one-eighth part of the circumference of the globe, from Guyaquil eastward. The truth is, that at Guyaquil, the dip, in the year 1821, is required by the hypothesis to have been 21° 13′, instead of 12° 11′, the quantity furnished to Dr. Sherwood, and from which he professed to derive, by his process, the latitude and longitude. If any one should here propose the question, by what magical process it is that Dr. Sherwood was able to determine the situation of a place, not previously known to him, not only by the use of an element which in its own nature must leave the situation indeterminate, but by the aid of a theory itself utterly irreconcileable with the professed result—I can only attempt a random solution. It is certainly supposable, in this instance, that the operator with Dr. Sherwood's process, upon the mention of the dip (12° 11′ 30″) and of the time of observation (1821) *might* recognize it as a dip with which he was already acquainted, and which he knew to have been observed by Capt. Hall, at Guyaquil.

Several other criticisms upon the documents accompanying the Legislative Report might be offered, but the few already made are sufficient for the object now in view, and perhaps even more than sufficient.

*New-Haven, August 3d,* 1838.

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## *Semi-Annual Report of the Water Commissioners, from the* 1st *of July to* 30*th December*, 1837, *inclusive.*

(Continued from page 66.)

### C

### Report of the Chief Engineer in relation to the Plan for crossing Harlaem River.

*New-York, December* 12, 1837.

To the Honorable the Board of Water Commissioners of the City of New-York—

Gentlemen,—In examinations made with a view of deciding on the most proper method, or plan, for carrying the Croton Aqueduct over Harlaem River, I find that the late Canvass White, Civil Engineer, in his report of January, 1826, to the Directors of the New York Water Company, proposed to carry the waters of the Bronx over this river, by means of iron pipes. The pipes to be supported on a "permanent stone bridge," which he proposed to construct at Macomb's Dam. The surface of water in the reservoir, from which it was received by the pipes, on the north side of the river, was about 80 feet above mean tide. No particulars were given in his report relating to the manner of constructing the bridge; but from the general plan, there is no doubt but he designed a bridge, only sufficiently elevated above the water of the river, to support his pipes and form a roadway.

John Martineau, Civil Engineer, in his report of January, 1835, to your Board, proposes to cross Harlaem River by an "inverted syphon," made of wrought iron, 8 feet in diameter, and supported on a bridge, composed of one arch of 60 feet span, over the channel way, and the remainder by a stone embankment 30 feet high.

D. B. Douglass, Civil Engineer, in his reports of November, 1833, and January, 1835, recommends a bridge of stone masonry, by which the regular inclination and grade of the aqueduct would be maintained. Major Douglass presented comparative estimates of the cost of this plan, and that of an "inverted syphon,"supported on a low bridge; and Doctor Martineau only of crossing by an "inverted syphon."

With some difference in detail, it therefore appears that Messrs. White and Martineau recommended crossing by iron pipes, supported on a low bridge, and Major Douglass by a high bridge, maintaining the grade line. Of the practicability of either of the two methods, there is no doubt. The great question is, to determine which, under all the circumstances, will most economically secure the desired object of passing the water over this valley. In the different methods that have been proposed, I have not been able to obtain the detail by which the several difficulties were to be overcome, and the estimate of expense obtained. The records to which I have had access, only giving the general features, and I have seen no drawings of either.

In order to present the subject fully to the consideration of the Board, I have, in compliance with your instructions, prepared plans and estimates of each method, which will be submitted with this report.

The width of the Harlaem Valley, at the grade line, 1450 feet; of which 620 feet is on the high water line of the river. The level, of mean tide is 118 below the grade level, or 131 below the top of the parapets designed for the bridge.

In April last, Mr. Carmichael was instructed to prepare a suitable float, and with sounding rods to examine the bed of the river. In the first place, he proceeded on the line of aqueduct as located across the river. He found no difficulty in sinking the rod through the mud; but the sand which lies in a great portion of the bed, from 4 to 8 feet deep on the rock; frequently requiring much perseverance to get through it. Commencing at the southern shore, rock was found at a pretty uniform level for 220 feet, and ranging from 24 to 33 feet below high tide. At this point the rock changed, and became very irregular, and a stratum of gravel at several places, prevented the rod from reaching the rock. Lines on each side of the centre, at 20 and 40 feet distant, were also examined; and both above and below the centre line, the rock was found *more* regular at less depth of water on the westerly side, and at a greater depth on the easterly side of the centre line. The result was less favorable than had been anticipated from previous examinations, and led me to direct surveys, with a view of finding a more favorable place for crossing. After all the examination was deemed necessary, a line parallel to the located line, and 60 feet westerly from it, was considered as presenting the greatest advantages for an aqueduct bridge. At this point the rock was found more regular, and varying from 32 feet near the south shore, to 20 feet below high water line, near the north shore. There is at this location a less depth of mud and sand, and consequently greater facility in constructing coffer dams. The sand is not a material impediment, and, in some respects, very useful; but the mud is likely to do much harm and no good. At this location the foundation of the piers will range from 18 to 32 feet below flood tide, and average about 25 feet. The elevation of the parapet of the bridge above the lowest foundation of pier will be 163 feet.

In deciding on a plan for an aqueduct bridge at this place, the depth to which the hydraulic foundations require to be sunk, involving heavy expenses in coffer dams and pumping, has an important influence in determining the span of the arches. After much examination, I have arrived at the conclusion, that 80 feet span for the arches over the river, and diminishing by one of 70 and one of 60, to 50 feet span for the arches on the table land on the north side, will most effectually combine stability, permanence, symmetry, and economy in the structure.

The piers for the large arches, from their great height, should be constructed hollow, in order to ensure stability, at the least expense. A greater width of pier is required to give support to the arch, and resist its horizontal thrust, than is required to bear the vertical weight of the superincumbent mass. In ordinary cases, particularly for arches of small span, it is the usual practice to give the proper breadth of pier, by filling the interior with rubble masonry, only dressing the face stone. But in piers of great height, designed for arches of large span, this method is not advisable, for the following reasons:

The interior masonry not being dressed as well as the exterior, is liable to settle more, and eventually force the face stone to bulge outward, and injure, if it do not destroy the work. A second reason is, the tendency that a large mass of masonry has to prevent the uniform and early hardening of the cement. The piers for the arches of 50 feet span, will be much lower, and may be made solid.

For all the hydraulic foundations, it is believed rock may be obtained; but for several of the piers on the table land, it is not probable we can find rock within a reasonable distance, and an artificial foundation of concrete and piling must be resorted to. This will require an excavation of 12 to 15 feet deep, in order to get the piles so low, as to prevent, in a great degree, their decay. The concrete should be filled about 3 feet deep, so as to constitute a safe foundation after the piles decay; at which time it will have become very solid.

The most difficult part of this work will be found in laying the foundation rock bare, and raising the pier above the water. All the other parts may be entered upon, and completed on well known mechanical principles. But the work of putting down coffer dams, in water averaging 25 feet deep, making the work impervious to water, and securing it against failure, from the great pressure that must act against it, involves much difficult labor, and is subject to great contingencies. Works of this kind have recently been accomplished in this country. The rail road bridge over the Schuylkill, near Philadelphia, has one of its piers on a hydraulic foundation of 29 feet deep; and the foundations of several of the piers, and one of the abutments for the Potomac Aqueduct, have been put down in 28 to 35 feet water, under the direction of Capt. Turnbull, of the U. S. Engineers, which shows the practicability of executing such works; and, at the same time, a history of their progress also shows that there is much contingency in their execution, and we are thereby admonished to make large estimates for similar work.

The plan of a coffer dam which I have prepared, and from which the estimate of expense has been made, is similar, in its general principle, to that last adopted by Captain Turnbull, on the Potomac Aqueduct. It is proposed, however, to excavate the mud between the pile sheeting, and allow the clay puddle to rest immediately on the sand which appears compact; and thus remove the difficulty experienced on that work, from the soft mud being forced through, between spaces that are sometimes unavoidably left between the pile plank, and thereby causing sudden and heavy leaks. This excavation in deep water will, doubtless, be attended with much difficulty and expense; but it is important that it should be removed, and I believe it may be done by means of dredging bags, if no better mode should be devised. This process of excavation is a slow and expensive one, but has been found effectual, in several instances, in dredging the channels of rivers in England. There is another point in which the work referred to experienced considerable difficulty, and which circumstances then did not admit of a similar remedy; that is, in the great strain which the earth in the coffer dam brought upon the tie timbers on the top, and which I propose to relieve by throwing a bank of earth, in the form of a triangle, on the outside of the dam.

The masonry of the hollow pier is designed to be of large stone, uniformly thick in each course, and to be dressed to a joint, not exceeding 3-16ths of an inch in their beds, and their upper and lower beds to be parallel. The vertical joints to have a draft equally close, and the centre and rear not to exceed half an inch. In other respects, the masonry is designed to be of similar character to that proposed in my report of the 8th February last, with such modifications as the peculiar character of the work demands.

It is believed that suitable stone may be obtained in the immediate vicinity, for all the work, except the ring or exterior arch stone. The quarry has only been opened to a very limited extent; and it is therefore possible, that it may not be found, for an extensive operation, as good as it now indicates. It is a gneiss rock, and presents more regularity of formation than is usual for its kind in this district. It has a good texture, and the appearance of great durability; and will be hard to work, both in quarrying and dressing.

In making the estimate for masonry, I have been governed by the value of work that has *much* similarity, as the same has been estimated for contract, by several of the most competent men in this department of masonry. We have no work that is *precisely* similar—that is, of the same magnitude; that from its elevation and inconvenience of access, will be as expensive in laying up; that requires so great a proportion of large stone, or the same exactness of execution; at the same time, there is sufficient resemblance to constitute a guide, that with careful application will not lead us materially astray in computing the expense.

The arrangement for guarding against leakage and the influence of frost, is similar to that proposed in my report of the 8th February last, for the Sing Sing Bridge, with the addition of an opening in the side or parapet walls, subsequently proposed for that bridge, in my report of 31st August last. The opening in the side walls was suggested by R. F. Lord, Esq., Engineer of the Delaware and Hudson Canal Company, and I consider it a valuable improvement.

ESTIMATE FOR ONE COFFER DAM.

| | |
|---|---|
| 5,500 cubic feet of oak timber, at 30 cents . . . . | $1,650 00 |
| 1,000 " white pine, at 18 cents . . . . | 180 00 |
| 90,000 feet board measure, of heart yellow pine, at $30 . | 2,700 00 |
| 20,000 " white pine scantling, &c., for scaffolding, at $16 . . . . . . . . | 320 00 |
| 2,000lbs, wrought iron straps, bolts and spikes, at 12 cents. | 240 00 |
| Pin timber and treenails, estimated . . . . . . | 50 00 |
| Driving 470 feet of sheet piling, at $2 . . . . . | 940 00 |
| Driving 60 guide piles, at $3 . . . . . . . . | 180 00 |
| Carpenter work and launching frame of dam, estimated . | 1,500 00 |
| Excavating from interior of dam, 600 cubic yards of mud, at $1 | 600 00 |
| 500 cubic yards excavation in foundation pit, at 50 cents . | 250 00 |
| Carried forward . . . . . . . . | 8,610 00 |

| | |
|---|---|
| Brought forward . . | $8,610 00 |
| 1,600 cubic yards puddled earth in dam, at 50 cents | 800 00 |
| Pumping during time of excavating pit, putting in lower timbers and raising the masonry above water, probably 90 days with a 20-horse engine, including use and repairs of engine and pumps, estimated at $20 per day | 1,800 00 |
| | $11,210 00 |
| Add for contingencies on account of the peculiar uncertainty of this work, 25 per cent. . . . . . . | 2,802 00 |
| Total cost for one pier . . . . . . . | $14,012 00 |

As a portion of the timber used in one dam may be drawn up and used in a subsequent one, or may be used for other purposes, the average for the seven piers may be put down at $13,000 each, or $91,000 for the whole.

Having given such a description as, I trust, with the plan herewith submitted, will present a satisfactory illustration of the basis on which the computation is made, I now proceed to present a detailed estimate of the probable expense of crossing the valley, by a high bridge, maintaining the regular inclination of the aqueduct.

### ESTIMATE FOR HIGH BRIDGE,

Maintaining uniform inclination of Aqueduct.

| | |
|---|---|
| 2,000 cubic yards excavation for foundation at 16 cents . | $320 00 |
| 500 bearing piles for foundation of land piers, at $5 . . | 2,500 00 |
| 7 coffer dams, including pumping and excavation of hydraulic pits, per detailed estimate, at $13,000 . . . . | 91,000 00 |
| 3,320 cubic yards in abutments and wings, at $8 . . | 26,560 00 |
| 480 " concrete masonry in foundation of piers on table land, at $6 . . . . . . . . . . | 2,880 00 |
| 20,550 cubic yards piers, at $18 . . . . . . | 369,900 00 |
| 3,460 " large arches, at $30 . . . . . | 103,800 00 |
| 1,090 " small arches, at $25 . . . . . | 27,250 00 |
| Centering for 16 arches, estimated . . . . . . | 30,000 00 |
| 5,480 cubic yards exterior spandrels and pilasters below water table, at $12 . . . . . . . | 65,760 00 |
| 3,660 cubic yards interior ditto and hance wall, at $6 . | 21,960 00 |
| 11,100 cubic yards parapets, including pilasters and all other stone masonry above water table, at $10. . | 111,000 00 |
| 1,060 cubic yards cut stone in water tables, parapet coping and ballustrade railing, at $30 . . . . . . | 31,800 00 |
| 1,170 cubic yards brick facing at $11 . . . . . | 12,870 00 |
| 1,320 lineal feet cast iron lining, at $25 . . . . . | 33,000 00 |
| 1,300 cubic yards foundation and protection wall, at $2 50 | 3,250 00 |
| 2,000 cubic yards embankment at 20 cents . . . . . | 400 00 |
| 115 feet of aqueduct masonry, from ends of bridge to intersection of grade level with surface of ground, at $31 . . | 1,495 00 |
| Total cost of High Bridge | $935,745 00 |

(To be continued.)

## *Fifth Annual Report to the Building Committee of the Girard College for Orphans; by* Thomas U. Walter, Architect.

(From the Journal of the Franklin Institute.)

Gentlemen:—I have the honor, in conformity with your resolution of the 26th inst., to communicate the following report on the progress of the work during the past year.

The marble work of the centre building is raised to the height of the third story floor; all the arches over the second story are completed, and the quoins are commenced for the vaulting to support the roof; nearly all the marble required to complete the cell of the building has been wrought —two of the large antæ capitals are finished, and the workmen are now engaged in executing the other two; three of the columns on the eastern flank have been raised to their destined height, two more are ready to receive their capitals, and two others are more than half finished; one of these columns has been fluted and entirely completed, and the fluting of another is nearly finished; several of the large architraves have been delivered; also about 7000 cubic feet of marble for bases, capitals, and columns, beyond what has been used, nearly all of which will be wrought during the winter.

The carpenters are now about commencing the centres for the third story arches, all of which will be ready to set as soon as the spring opens.

The easternmost out-building, which embraces the dwellings of the Professors, is nearly completed, and the building nearest the College is in such a state of forwardness as to admit of its being finished (if required) in three or four months; I am, however, of opinion, that neither of these buildings should be entirely completed until the time shall have been agreed upon for occupying them, as new buildings deteriorate much faster without occupants than with them; it would, therefore, be better to keep them in such a state of forwardness that possession may be given at a few weeks' notice.

The whole quantity of marble that has been delivered during the past year, amounts to 37,648 cubic feet; 31,974 superficial feet have been wrought and used in the building, and there are now on the ground about 13,500 feet of finished work, 1828 feet that have been sawed principally fer ashlar, and 5564 cubic feet in the rough.

There have been 873,150 bricks delivered at the work during the last season, which, together with the 500,000 left on hand from the previous year, make 1,373,150, of which 1,211,150 have been used in the building, leaving 162,000 bricks now on the ground.

All the contracts, have been faithfully executed and every part of the work reflects the highest credit upon the superintendents of the various mechanical branches; an unusual degree of skill and industry has been evinced by the workmen, and the most perfect harmony has prevailed in all the departments of the work.

The delivery of marble during the past year has fully equalled our expectations, and there remains no doubt that the contractors will be able to continue the supply as rapidly as it will be required.

The expenditures, from December 31st, 1836, to December 30th, 1837, amount to $181,839 79.

There is now on the ground about $85,000 worth of materials and workmanship which have not yet been used in the building, and which includes capitals, bases, column blocks, and architraves for the portico, the marble for finishing the cell of the main building, and the steps and yard walls of the out-buildings, all of which will be available for the work of next season.

The building is now in a situation to admit of more work being done during the ensuing season than has been accomplished in any one year since its commencement; the marble work of the cell being nearly completed, there will be nothing whatever to interfere with the progress of the brick work; all the arches of the third story may therefore be constructed, and the building prepared for the roof, before the close of the season, the columns and architraves of the flank porticoes, and the steps and yard walls of the out-buildings, may also be readily finished during the next year, as the whole attention of the stone-cutters will be directed to these objects: about $285,000 will be required to accomplish this amount of work; it therefore only remains for you to say whether the buildings shall be advanced thus rapidly or not.

A temporary roof has been constructed over the whole of the main building, and the greatest precaution has been taken to prevent injury from frost; conductors have been made to lead the water from the top of all the arches into sinks in the cellar, for the purpose of preventing the rains that fall on the work during the summer from percolating through the abutments and arches, and saturating the work in the lower stories.

Temporary furnaces for drying and warming the building during the winter have also been constructed, and the warm air introduced into every room in the house, notwithstanding the unfinished state of the work; this arrangement was deemed expedient, not only to prevent injury to the arches from congelation and consequent expansion by cold, but also for the purpose of evaporating as much dampness from the walls as possible, previous to the occupancy of the building.

The expansible properties of *iron* having been a subject of considerable conjecture in reference to the bands for resisting the lateral pressure of the arches, I was induced to make an experiment for the purpose of discovering the actual difference of temperature produced in the middle of the walls, by the extreme heat of the summer and the severest cold of winter.

Although I have never had an idea that any evil could possibly result from the expansion of the iron in question, by an increase of temperature, the materials which surround it being subject to an expansion almost (if not quite,) equal to that of the iron, yet the satisfaction to be derived from positive evidence on the subject is sufficient to give interest to the experiment; I shall therefore give a brief account of the manner in which it was conducted, so as to enable you to judge how far the result may be relied on.

The place selected for the experiment was the brick wall between the south vestibule and the large rooms; the thickness of this wall is five feet five inches, and its distance from the south front of the cell twenty-six feet; the sun had therefore full power upon it during the summer, and in the winter the whole building was covered with a temporary roof: I should also remark, that the experiment was completed before any fires were made in the furnaces.

On the 23d of September, 1836, the temperature on the work being at 82° Fahrenheit, a self-registering *minimum* thermometer was placed upon the iron band in the middle of the wall, and the work constructed as solidly around it as the rest of the building.

On the 29th of July, 1837, the temperature being again at 82°, a hole was made in the wall, and the thermometer taken out, when it was found that the register had descended to 42° during the intermediate winter, the extreme cold of which was 3° below zero: thus we find the greatest cold in the middle of the walls to be 42°.

On the 16th of January, 1837, the temperature on the building being 24° Fahrenheit, a self-registering *maximum* thermometer was placed on the iron band in the middle of the aforementioned wall, on the same horizontal line with the other thermometer, and about sixty feet distant from it, a space having been left in the wall when it was built, for the purpose; which space was walled up around the thermometer as firm and compact as the rest of the work.

On the 16th inst., the temperature on the building being again at 24°, the walling was taken out, when it was found that the register in the thermometer had gone up to 61° during the intermediate summer, the greatest heat of which was 94°.

We have therefore 42° for the lowest temperature of the iron bars, and 61° for the highest, making a difference of 19°.

The expansion that an increase of temperature of 180° produces upon malleable iron, is given by Dr. Ure, in his Dictionary of Chemistry,* as follows:

From experiments by Smeaton $\frac{1}{794}$ of its length; according to Borda's experiments $\frac{1}{865}$ of its length; and according to Dulong and Petit $\frac{1}{846}$ of its length.

Mr. Hassler, (of New-Jersey,) in his "Account of Pyrometric Experiments," read before the American Philosophical Society, June 29, 1817,† finds the expansion to be equal to $\frac{1}{798}$ of its length; and in a work on Natural Philosophy, by Biot,‡ we have the experiments of Lavoisier and Laplace, made in 1782, giving an expansion, under the same increase of temperature, equal to $\frac{1}{819}$ of its length.

The trifling difference in these results may be attributed to a difference in the density of the material.

Now, if 180° will increase a bar $\frac{1}{794}$ of its length, (this being the greatest expansion obtained by the foregoing experiments,) 19° will lengthen it only $\frac{1}{7526}$; hence the bands around the rooms of the College, (each being 54 feet long from the points of support,) will be subjected to a difference in their length between the extreme heat of summer and the severest cold of winter, of $\frac{1}{7526}$, or $\frac{1}{12}$ of an inch.

This being the actual difference produced in the length of the iron bands, by the greatest change of temperature to which they can be subjected, it remains for us to consider the expansibility of the materials with which they are surrounded.

A table on the expansion of different kinds of stone, &c., from an increase of temperature, is given by Mr. Alexander J. Adie, civil engineer, in a paper read before the Royal Society of Edinburgh, on the 20th of April, 1835,|| in which he makes the expansion produced upon bricks by 180° of Fahrenheit, equal to $\frac{1}{1818}$ of its length, or $\frac{1}{26}$ of an inch in 54 feet under an increase of temperature of 19°.

If, therefore, the maximum expansion of one of the iron bands in the wall of the College is $\frac{1}{12}$ of an inch, and the brick work surrounding it $\frac{1}{26}$, the difference is then reduced to nearly $\frac{1}{22}$ of an inch: but if we consider that the variation of temperature in the interior of the wall is only 19°,

* Ure's Dictionary of Chemistry, page 272.

† Transactions of the American Philosophical Society---new series-- Vol. I. p. 227.

‡ Physique de Biot, Vol. I.

|| See Journal of the Franklin Institute of the State of Pennsylvania, Vol. XX. p. 200.

while the exterior is subjected to the extremes of heat and cold, it will be obvious that the aggregate expansion and contraction of the brick work is even greater than that of the iron.

From these considerations it is evident that not the slightest injury can possibly result from the use of iron in the construction of the College.

I am, gentlemen, very respect fully your obedient servant,

THOMAS U. WALTER, Architect.

*Girard College, December 30th*, 1837.

To JAMES HUTCHINSON, ESQ.

*Chairman of Building Committee, Girard College for Orphans.*

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*Specification of a Patent for a process for protecting articles made of Iron or Steel from oxidation. Granted to* M. SOREL, *of the city of Paris in the Kingdom of France. December*, 1837.

To all whom it may concern; be it known, that I, M. SOREL, of the city of Paris, in the Kingdom of France, have invented, or discovered, a process, method, or methods, by which various articles made of iron or steel, may be effectually preserved from oxidation, or rusting, by the galvanic action produced by zinc, and I do hereby declare that the following is a full and exact description thereof.

It is well known to chemists and to all persons versed in the physical sciences, that a galvanic action is produced by the contact of two metals different in their natures, and that the most oxydable of the two metals so brought into contact becomes positively electrified; whilst that which is least oxydable becomes negatively electrified,and also that,when brought into this state, the most oxydable, or positively electrified metal, has a tendency to become oxidized, and will abstract oxygen from compounds containing this agent; whilst the least oxydable of the two metals will be protected from oxidation, although exposed to agents which would oxidize it, but for the contact of the negative metal. My process depends, for its efficiency in protecting iron and steel from oxidizing, or rusting, upon the manner in which I apply this principle.

The process of covering articles of iron with tin is well known, and is exemplified, most largely, in the manufactory of what is usually known under the name of sheet tin, or tin plate, which consists of thin sheets of iron coated with tin. In this material there is necessarily galvanic action between the two metals, but it is to the disadvantage of that which it is proposed to protect, namely, the iron, which being more oxydable than tin, becomes positively electrified, and has its tendency to rust increased; the protecting effect of the tin depending in this case entirely upon the perfectness with which the iron is coated by it; as is clearly evinced by the rusting of the iron whenever any portion of this coating is removed, and the iron is exposed to the action of air and moisture. Were the galvanic action in favor of the iron, it would be protected notwithstanding the abrasion of the tin, as its protecting influence is not limited to the mere point of contact, but extends far beyond it.

In the scale of the oxidability of the different metals, commencing with those which are the most oxidable, it has been found that zinc stands before iron, and it follows therefore, that when these two metals are brought into contact, a protecting influence will be exerted upon the iron by the zinc, and that the rusting of the former metal will be thereby prevented.

It might be supposed from the fact that zinc is more oxidable than iron, that this metal, if employed to protect iron, would itself soon become oxidized, or rusted, and would consequently, leave the iron unprotected; and such reasoning would undoubtedly be just, but for another fact, well known to chemists, that there are certain metals, of which zinc is one, which after they have acquired a thin superficial coat of oxide, are thereby effectually protected from the further absorption of oxygen, under ordinary exposure.

Having thus fully exemplified the principle upon the application of which my process is dependent for its efficacy, I will now proceed to give the necessary details, and the various modes which I have devised, for carrying the same into operation. These modes which I have essayed, are five in number, and are as follows:

*First*, applying the zinc to the iron or steel in the manner in which tin is applied in the process of tinning.

*Second*, applying a galvanic powder in the manner of paint, which consists in mixing the zinc, reduced to fine powder, with oils or resinous materials, so as to form a paint or varnish, with which the substances to be protected are to be covered, in the ordinary manner of painting, or varnishing.

*Third*, covering the articles to be protected, with the galvanic powder, consisting of zinc finely comminuted.

*Fourth*, wrapping the articles to be protected in what I denominate galvanic paper.

*Fifth*, anointing or covering the articles with a galvanic paste, consisting of any suitable fatty matters, such as purified lard, in which the galvanic powder has been freely mixed.

The first process, that of coating the articles to be protected with metallic zinc, is to be effected much in the same manner in which tinning is performed, that is to say, the articles to be coated must be rendered clean, and free from oxide, by processes analogous to those followed in preparing them for ordinary tinning; such as immersing them in diluted sulphuric or muriatic acids, scouring them, and so forth; which processes being well known, need not to be described. The zinc, in like manner, must be fused in proper crucibles, or other convenient vessels, adapted to the nature and and size of the articles to be operated upon; special care being taken to keep the metal covered with sal ammoniac, or other proper flux; and to regulate the heat in such a way as is required by the volatile nature of the metal. The articles to be coated, after being dipped into the melted zinc, are to be withdrawn slowly, that too much of the metal may not adhere to them. They are then to be thrown into cold water, rubbed with a sponge, or brush, and dried as quickly as possible, as otherwise they may be injured by the appearance of dark spots, which it is desirable to avoid.

When chains for cables, or for other purposes, are being withdrawn from the zinc, they must be shaken until sufficiently cooled to prevent the links from being soldered together by the melted metal. The coating of small chains requires careful management, but by the following procedure it is effected without difficulty. Whilst in the dilute acid, they are to be moved about to expose all their parts equally to its action, they are then to be dipped into muriatic acid, and immediately dried in a reverberatory furnace. The melted zinc being ready, and covered with sal ammoniac, the chains are to be put into it, and suffered to remain there about a minute; they are next slowly taken out by means of an iron skimmer, or other convenient instrument, which will allow as much of the zinc to drop from them as can be got rid of in that way; the links, however, will still retain too much zinc, and will be soldered together. To correct this they are to be put into a reverberatory furnace, to be covered with charcoal, and retained at a red heat for about a quarter of an hour, during which time they are to be moved about by means of an iron poker; by this treatment the excess of zinc will be discharged; they are kept in motion until the zinc is solidified. When small nails, and such like articles, are to be coated, the process should be performed in small crucibles, this being necessary to prevent the danger of spoiling considerable portion of zinc, which results when iron has been kept in it for a considerable length of time, as it is thus rendered unfit for the purpose of a protective coating. In all cases the purest zinc should be employed. Wire may be coated by passing it through the melted zinc, as it is wound off from one drum or reel on to another.

When articles of iron have been coated with zinc, it is sometimes desirable to cover this coating with one of tin; more especially when culinary vessels are the subjects of the operation. It may also be resorted to when it is desired to give a brighter and more handsome surface than the zinc affords; such a coating of tin will not destroy the galvanic effect of the zinc; and it is to be effected in the ordinary way of tinning, particular care being taken not to heat the tin too highly, or to keep the articles in it so long as to remove any portion of the coating of zinc.

The galvanic powder, consisting of zinc reduced to that state, may be obtained by various means; the following, however, I have found to be the most economical of any which I have essayed.

The zinc is put into a reverberatory furnace, and brought nearly to a red heat, care being taken to prevent the access of a current of air; it is then carefully skimmed, and covered with sal ammoniac.

Iron filings, equal in weight to about one-tenth part of the zinc, are to be moistened with muriatic acid, and thrown on the fused zinc; the whole is to be covered with finely pulverized charcoal, and the heat of the fused metal raised to whiteness, and so retained for a quarter of an hour, agitating it at intervals by means of an iron poker. The melted mass is then to be run off into a brick or cast iron reservoir, which is covered with a plate of cast iron to prevent the combustion of the zinc. Through an aperture on the cover, a poker, or stirrer is to be introduced to agitate the alloy, which is to be done until it is cool, when it will be in fine powder.

The galvanic paint is prepared by grinding this powder with the fluid which is to be employed to form it into a paint, or varnish. Various fluids may be used for this purpose. I have sometimes employed the oil distilled from coal tar. Coal tar itself answers well, with the addition of one-third of spirits of turpentine, or of a sufficient quantity to bring it to a proper consistence. For purposes where the odour of this mixture would be objectionable others may be substituted.

Articles of polished steel, or iron, packed in this galvanic powder, so as to be covered thereby, will be preserved from oxidation, even should they become moistened from any accidental cause.

Galvanic paper may be prepared either by the mixing of the powder with the pulp in the manufacturing of the article, or by taking the ordinary wrapping paper, coating it with any suitable adhesive substance, and sifting the galvanic powder over it. Polished, or other articles, wrapped in such paper, will be effectually protected from rust by the galvanic action.

The preparation of the galvanic paste has been sufficiently explained, and its operation in protecting the articles coated with it will be readily understood, as it is analogous in this respect to those previously described.

Having thus fully explained the principle upon which my process of protecting iron and steel from rusting, or oxidating, is dependent; and having also given the various modes in which I have contemplated the carrying the same into effect, I do hereby declare that what I claim as of my invention, and wish to secure by letters patent, is the employment of zinc, in various forms, as a covering to the respective articles to be thereby protected, as herein set forth. I do not claim to be the discoverer of the principle of the protection of metals from oxidation by galvanic action: nor do I claim to be the first to have proposed the employment of zinc from the preserving of iron therefrom; masses of zinc having been applied, or it having been proposed to apply it in masses, to steam engine boilers, and probably to other articles, with this intention; but from this, my plan, or mode of procedure, differs as obviously as it surpasses it in efficiency, and in its applicability to numerous purposes in the arts where the application in masses would be impossible, or altogether unavailable. —*Ib.* SOREL.

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## *Lead Mine in Davidson County, N. C.*

Extract of a Letter from Dr. AUSTIN, the senior Editor of the Western Carolinian, written from Davidson county, on the 27th June:

"Being in the vicinity of the *Lead mine* of Messrs. King, Thomas, and Company, I called to see the progress they are making in the work. Since my visit several weeks ago they have made considerable progress, and the place begins now to assume quite the appearance of a mining establishment: several houses have been built for the accommodation of the workmen; a substantial dam has been erected across the small creek near the mine, and pretty extensive works for washing, and cleansing the ores have been finished, and perform their offices well. A furnace too, for smelting the ores is nearly completed. The calculation of Mr. King is, that about the 4th July, the furnace will go into operation, and the smelting progress commence. The Company at this time, have 48 to 50 hands at work on the various operations connected with the establishment, and it is probable their number will soon be increased.

This vein, or lode of lead, was discovered last Fall by the owner of the land, who afterwards sold it to Mr. Roswell A. King & Co.,—the enterprizing gentlemen who are now carrying it on. He saw the indications of the ore on an elevated place in his field, where the back of the vein pointed out, and supposing it to be a gold, or silver vein, commenced sinking a shaft, and in the depth of a few feet struck into a perfect mass of ore, which turned out on trial, to be very rich. Mr. King & Co., have sunk or rather are now sinking two shafts some distance in advance of the first opening, with a view of cutting the vein at a depth of 90 or 100 feet; at the depth of 60 feet, they drove an adit to the vein, and found it to be large, and yielding quantities of fine ore. Thus far, the prospects of this lead mine are very flattering, and promise ample remuneration to the gentlemen engaged in it, for their spirit, and enterprize.

The character of the ores of this mine is what mineralogists call carbonate of lead :—there are but few mines of this kind of ore in the world. It is said that the ores of the Le Motte mine in Missouri, are of this description. Most beautiful chrystals, or rather clusters of chrystals, are occasionally found in the ores taken out at this place. I have brought away with me several as Cabinet specimens. There are also large masses of what may be called the earthy oxide of lead, which, from all appearances are quite rich with the metal; I think it very likely that these ores are at a great depth, or in other parts of the vein, may assume the sulphuret character: in fact there are some strong indications of the change. I do not know that this change, should it take place, will add anything to the value of the mine, as I understand the Carbonate ores, are as easily managed as those of a Sulphuret character.

The crops in Davidson are promising. Wheat is very fine. Cotton is small, but has a good color, and is thrifty. Corn is rather backward for the time of year, but generally looks well.

A few days ago I visited the Lexington Cotton Manufactory, which is now on the eve of being started. It is a very fine establishment, and every thing about it seems to be admirably arranged. The Company have engaged as Manager a gentleman by the name of Kerns, who has extensive experience in the business, and whose skill and industry I doubt not will soon show themselves in successful results. This establishment will be quite an ornament to Lexington, and the gentlemen engaged in it deserve, and will meet success for the very spirited manner in which the whole enterprize has been gotten up, and thus far carried through. Davidson is the daughter of Rowan, but she seems to be going ahead of her parent.

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## *Royal William Steam Ship.*

*New-York Harbour, July 24th,* 1838.

To the Editor of the Courier and Enquirer—

Sir—As the American public took so much interest in the success of the "Sirius" and "Great Western," shewing by the kind reception they gave to the commanders of those vessels how sincerely the people of the United States were gratified at the solution of the great problem of crossing the Atlantic by ships propelled by machinery, I am confident I shall add still more to the public gratification, and more particularly to that of the scientific portion of the population, by giving a concise statement of the result of the "Royal William's" voyage from Liverpool. The ship left the river Mersey at 6h. 30m. P. M. of the 5th July, and arrived at her anchorage here at 5h. 35m. P. M. of the 24th of July, being 18 days 23 hours on the passage; but if I deduct three hours and a half, during which time her machinery was stopped for the purpose of attaching new packings, &c. when 9 days from Liverpool, the total time occupied in *steaming* was eighteen days nineteen hours and a half, and that *without any intermission whatever in working the machinery.* From Pilot to Pilot she was 18 days 19 hours. The "Royal William" is 276 horse power, on the condensed principle; she has three separate circular boilers worked at pressure under 8lb the inch; and the steam is economised by expansive valves. During the entire voyage across the Atlantic, the average expansion was 19 inches of a 66 inch stroke, and her total consumption of fuel was 351 tons 2cwt 2qrs from anchorage to anchorage, leaving a sufficient quantity on board for 600 miles additional steaming, having still in her hold 59 tons 7cwt. She has worked the whole distance at an average of 2cwt. 11lb per mile, or going more into scientific detail, 6lb. 4oz. per horse power per hour, a result, I believe, unprecedented at least in Europe.

Leaving England in the middle of summer, it may be said that her voyage has been long, and that her predecessors did more than she has done. To prevent such an erroneous opinion going to the world, I give below a detailed statement of the different winds she has encountered on the passage; winds as adverse as any winter season generally produces, and as a proof that the Atlantic has been visited with Westerly gales, I beg to state that in latitude 42 and longitude 61, we overtook the "Sir James Kemp," out 58 days from Dundee. and in latitude 40 29, and longitude 68 18, we passed the "Hibernia" which vessel left Liverpool on the 17th of June, 18 days before the "Royal William." The undernamed Packets have not yet reached New York, and as their usual passages are much shorter than that they are now on, nothing can show more clearly the adverse weather in the Atlantic for vessels coming to the westward.

| | | | |
|---|---|---|---|
| North America, | left | 16 | June. |
| Roscoe, | " | 24 | " |
| William C. Nye, | " | 26 | " |
| Louisville, | " | 26 | " |

Total time of the Royal William between Liverpool and New York, 18 days and 23 hours.

| | Days. | Hours. |
|---|---|---|
| Winds blew from N.W. to S.W. | 11 | 11 |
| N.W. to North | 2 | 17 |
| S.W. to South | 2 | 0 |
| Easterly | 1 | 17 |
| Calm | 1 | 2 |
| | 18 | 23 |

Now as the course from Cape Clear to New York is about W. by N. it is evident the "Royal William" had to contend against eleven and a half days of *opposing* winds, that is to say, those blowing between S.W. and N.W.; and as it frequently blew gales, I trust some credit will be given to a vessel which has opposed them so successfully. For the first eleven days she had no opportunity for setting her fore sail or fore top sail. As a proof of her capabilities for speed, it is only necessary to give the result of the last seven days she was at sea, during part of which time she had 56 hours of head-winds—

| | | |
|---|---|---|
| Noon ending 18 July, | —206 | miles, |
| 19th " | 240 | " |
| 20th " | 182 | " |
| 21st " | 179 | " |
| 22d " | 230 | " |
| 23d " | 239 | " |
| 24th | 239 | " |

Total in seven days, 1,514 miles

The above are by *observations*—by dead reckoning she ran 257 miles on the 23d.

The "Royal William" is fitted up with water tight bulk heads, which by dividing the hull into five compartments, renders it perfectly safe under almost any circumstances; certainly from collision or fire; this plan of dividing the vessel into sections, was originally adopted by Mr. C. W. Williams of Liverpool, to whom the public are indebted for so great a means of preservation to human life, and which has gained him in England the applause of the public at large. The "Royal William" belongs to the City of Dublin Company, established in 1824, to run steamers between Liverpool, Dublin and Belfast. They have a fleet of 17 vessels employed in the Irish channel, which make annually about 1000 voyages, and from the peculiar care used in their construction, and from almost daily inspection, not an accident has occurred to endanger life during a period of 14 years.

The experience acquired by the Managing Directors has led parties in the United Kingdom to solicit their assistance in the formation of a Company to run Steamers of a large class between Liverpool and New York; and in consequence of that assistance being afforded, progress has been made. Subscribers have come forward, and two vessels of 1,250 tons and 420 horse power each, are now in course of construction, to be followed by others as numerous as the wants of the station will ultimately require. I am, Sir, your obedient servant,

Jas. C. Shaw, Marine Manager.

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From the Army and Navy Chronicle.

## *English and American Steam Engines.—Steam Ship Great Western and U. S. Steamer Fulton.*

Mr. Editor: I have to ask the favor of your allowing me, through the medium of your columns, to reply to an article that lately appeared in the British and Foreign Review, on "Maritime Steam Projects," and at the same time to furnish some comparative data in relation to the steam ship Great Western and the U. S. steamer Fulton; the former acknowledged to be the *chef d'œuvre* of English manufacture, and the latter an *experiment* on the part of the Navy Department, to test the practicability of applying steam to vessels of war.

The article above alluded to, thus reads:

"The maritime steam projects now being carried on are grand enough to satisfy the most ardent mind for at least a quarter of a century to come. The Government [British] has determined to support the communication with the East by way of the Mediterranean, Cairo, Cossein, and the Red Sea. But no energy and devotedness, backed even by the wealth of the East, will, with the present machinery, which is behind the age, stem the opposing monsoons. It is, however, as we will show, to be accomplished. It is cruel, to exhaust the minds, the thews and sinews of such men as Chesney and Waghorn, and many more, by a pertinacious adherence to antiquated and imperfect systems, solemnly maintained by the assumptive cautiousness of pretended wisdom. The voyage to Alexandria may be *expensively* performed by boats of the common construction. The monsoons are to be met and overcome, the short head seas to be ploughed through, and the passage unerringly made by means of the high pressure steam only."

"The boats intended to attempt the passage to North America are nearly completed. They are about the tonnage of an eighty gun ship, and all that skill can do to render them worthy of the enterprise has been done; but the engines are low pressure, and occupy so much space, and are so heavy, that it may be doubted their being able to carry a sufficient supply of fuel, particularly if they were to be opposed by adverse gales. With fine and simple high pressure engines, and using distilled water, they would have performed the voyage easily. The same observations are applicable to the intended passage by steam round the Cape of Good Hope. High pressure engines and distilled water must be adopted, or it will fail."

To a person unacquainted with the objections to the English condensing engines, (low pressure) this mention of high pressure as the plan of engine, would not be construed in a manner at all flattering to the philosophy of the writer; for, if he does not mean that the conventional unit of weight and velocity, termed horse power, is more powerful in a high than in a low pressure engine, it is a fair testimony of a tacit acknowledgment of the practical inefficiency of their condensing engines to propel a vessel against an undue resistance in the winds or currents, and to perform long voyages, in consequence of their immense weight and bulk; the former supported by lessening the space and impairing the qualities of the vessel as a "sea boat," and the latter accommodated at the expense of capacity for fuel and stores.

Now as one of the leading objects of this reply is to point out the inefficiency of English Engines when compared with those of this country, for the purposes of sea navigation, on account of their undue weight and consumption of fuel, the following acknowledgment on the part of their advocate, is very opportune for my purpose, as it is fair testimony of the absence of improvements of *their* present engine, over that of the inventor, Watt—

"The size and weight of the boilers make larger vessels necessary than are required for the duty they are intended to perform, and thus the first cost is considerably increased, and afterwards all the charges; the quantity of merchandize proportioned to the tonnage cannot be stowed, and the extent of cabin room is curtailed. In bad weather the vast weight is so high, that the vessel rolls, and labors, and strains, and those evils are increased from the vessel being of light draught of water; the dimensions and weight of the boilers and machinery prevent the stowage of fuel; thus shortening the distance the vessel can go without a fresh supply. There are other minor evils, which it is unnecessary to dwell on here. It cannot be denied that able machinists have done, perhaps, nearly what can be accomplished with the low pressure engine of Watt, on which scarcely any great improvement has been made since it was first used. Proportion, strength of parts, properly adjusted, the condenser, and some details, are all that even his talents produced."

The *capability* of the writer to draw correct conclusions respecting the merits of American engines, together with his *impartiality* and tact at levelling unmerited abuse upon work as far superior to that of his country, as the following aspersions are devoid of an approximation to the truth, with the single, and to us creditable exception, that with our vessels, built exclusively for river navigation, the boilers "are chiefly on deck."

"Before we enter more minutely in this important branch, we must, in justice to our country, unequivocally state, that the declaration of the superiority of American steamboats is a mere delusion. One of the most competent judges informed us, after a minute inspection, that the steamboats on the North American rivers were in a deplorable condition; most of them with the balance beam of yore, made of wood, with the machinery of the coarsest workmanship, and boilers chiefly on deck, so imperfectly constructed as to be disgraceful to mechanics: their high pressure, the mere abortions of ignorant and reckless men."

But to return to the writer's assertion that high pressure engines only must be used. I would ask him if he is aware of the risk and expense of using high pressure boilers upon salt water, especially upon the Red Sea, the water of which is of greater specific gravity than even the ocean, and deposites a greater proportion of sediment, when submitted to the action of heat, and especially that degree requisite to afford steam of sufficient density to be classed as high pressure; and hence the necessity of having a double set of boilers for each engine, if the vessel is required to be kept in operation for a period of ten or twelve consecutive days; and consequently incurring nearly as great weight, and occupying a greater space, in boilers and furnaces, than with one set of boilers for a low pressure engine of equal power; and that, if to avoid the double set of boilers, "distillation" is resorted to, the engine is rendered a condensing one, unless an apparatus separate from the engines is used, which will occupy a greater space than the boilers, for the supply of which this apparatus is resorted to; to all of which objections, another, and by no means of the least importance must be added, which is the increased consumption of fuel per horse power, in a high pressure engine over a condensing engine, which fact the writer has certainly forgotten, for his great *practical* experience must have made him acquainted with it.

Again—

"Having condemned the present machinery of steamboats as obsolete, behind the age, and as reducing the profits and increasing the first expense, we deem it our duty boldly to state what we consider would be a great progressive step.

"Every steam ship should be built of iron, with compartments reaching above the water mark; with them she could not founder: being built of iron she could not burn.

"No steam ship should use salt water in her boilers; to do so is disgraceful to science. Distilled water only should be allowed to be used."

On this point all American engineers must, and do fully agree with the writer, and commend him for his candor, though they cannot for his consistency; for, of a certainty, English engines are not only obsolete (in this country) but are far behind the age. Many portions of the Great Western's engines are only known here by history, having long since been discarded as useless, in comparison with arrangements that have far superseded them, both in practical efficiency and mechanism.

In support of what has been advanced respecting the comparative merits and disadvantages of the engines of the two countries, I will give a detailed statement of the power, speed, and space occupied by the engines and boilers of the

GREAT WESTERN AND FULTON.

The former having engines (according to the American estimate of 44,000 lbs, with the ordinary pressure and revolutions, steam cut off at even one-half the stroke of the piston,) of 375 horses power,

| | |
|---|---|
| Bucket surface in superficial feet . . . . . . . | 550 |
| Speed of periphery of wheel, in miles per hour . . . | 14½ |

| | | | |
|---|---|---|---|
| Space occupied by boilers and engines in cubic feet | | | 56,100 |
| Weight of Engines | 400 tons | | |
| do. boilers (iron) | 88 do. | | |
| do. water in do. | 100 do. | total | 588 |

Consumption of fuel, according to the *very lowest* estimate given, one and a quarter tons of coal per hour, (the estimate given by the engineer was two tons.)

The Fulton has engines, at the ordinary pressure of 12lbs. and 21 revolutions, steam cut off at one quarter the stroke of the piston, of 460 horses power.

| | | | |
|---|---|---|---|
| Bucket surface in superficial feet | | | 552 |
| Speed of periphery of wheel in miles per hour | | | 17⅛ |
| Space occupied by boilers and engines in cubic feet | | | 26,622 |
| Weight of engine | 78 tons | | |
| do. boilers (copper) | 88 do. | | |
| do. water in do. | 41 do. | total | 207 |

Consumption of fuel one and a quarter tons per hour.

Thus it appears that the Fulton with engines of 85 horses power greater than the Great Western's, and with an excess of speed of wheel of two and two-thirds of a mile per hour, burns but the same quantity of fuel, at the minimum estimate of the latter, being a difference of one and four-tenths of a pound less per horse power per hour; and that the engines and boilers of the different vessels occupy space in the proportion of 27 to 56, one exceeding the other by a space in which 228½ cords of wood or 634 chaldrons of coal, could be stowed, and have a difference of weight of 381 tons; all of which advantages are in favor of the Fulton, which I trust will be taken as conclusive evidence in favor of the efficiency and superiority of American steam engines and boilers over those of English manufacture.

And if one of my age and pretensions might be allowed to advise, with these facts to support him, I would say to our transatlantic friends, first correct the unseemly apparatus and immense *water tanks* you term steam engines and boilers, and keep pace with the improvements of the age and British science in other branches, before you enter into ill-judged and unmerited comparisons, as well as schemes founded upon an impracticable basis.

To my countrymen, on this side of the Atlantic, learn that to indulge in encomiums upon the manufactures of other countries, at the expense of your own, is not always indicative of either a knowledge of the subject, or good sense, and that while America can boast of names that will still shine as conspicuous in the history of the steam engine as those of any other country; they should not suffer it to be said, that while history records the name of Fulton upon her brightest page, genius mourns the ingratitude of his countrymen. A Young Engineer.

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The following remarks are so entirely coincident with our own views on the subject, that they may replace an article we had prepared to the same effect.

We think, with Dr. Parkman, that the public in general have a much greater responsibility in the mattter than is commonly supposed. Improper boats or machinery would not be used if an enlightened public refused to encourage them.

## *Moral Causes of Recent Disasters.*

The following are extracts from a discourse delivered in the New North Church, in this city, by its Pastor, (Rev. Dr. Parkman,) on the Sunday immediately following the recept of the intelligence of the wreck of the Pulaski.

"You know not what shall be on the morrow"

My friends,—rather in such a connexion I should say—my fellow citizens, it is high time to awake out of this sleep. It is your solemn duty to inquire—'What is the *cause?*' or none of you may tell, what shall be the end of these things. And I appeal to your own reflection, if there be not the utmost reason to fear, that among the causes of these fearful calamities, immediate or remote, we must number—first a sordid avarice, seeking out *the cheap* to the rejection of what is solid; neglecting necessary, because, forsooth, expensive precaution; a rash confidence, presuming that what was safe to day shall be safe to-morrow; a passion for progress not less childish, than it is ruinous, providing even in the very construction of the vessel for speed rather than security; a spirit of competition as mad as it is mischievous, careless of life in its wild and unprincipled gratification; and then—and a most fruitful source of evil—the reposing of trust, where trust should never be reposed, with incompetent and reckless hands, with men that have no prudence, nor vigilance, nor self-control, and whose passions are their masters; and last—and worst of all Intemperance* that all-comprehensive, that all but omnipotent mischief, confounding all wisdom and making fruitless all caution—these, my brethren, and such as these, have been but too often the guilty causes of these heart-rending accidents.

Nor is it to proprietors or agents or commanders alone that the blame is to be ascribed.—Passengers, even for pleasure, hastening as for their lives, they scarcely know whither or for what, or intent on some scheme of business, or sudden speculation, that shall lift them out of the dust and set them with princes, will grow impatient of a delay that is wise, and urge on by entreaties and even bribes to a haste, that is ruin; countless examples of this childishness and insanity might be adduced.

Whence is it, fellow citizens, that in Great Britain and other parts of Europe, in seas also, where navigation is difficult and hazardous, we hear so seldom of these horrors. It is because men are willing to move not with the wings of the wind, or as the lightning, but with the progress appointed to men. It is because the government protects by its laws the lives and the property of the subject; and will not permit men's madness to be their ruin; nor an imaginary individual right to be exercised to the public wrong. It is because they make responsible with life or liberty, those who are entrusted with sacred interests, and punish carelessness and presumption, such as have been the causes of countless evils here, as crimes.

My brethren, it is not my practice, as you know—for I freely confess it accords not with my principles—to bring topics of doubtful moment to

* The dreadful wreck of the Rothsay Castle between Liverpool and Dublin, a few years since, in which more than a hundred perished, and among them many precious lives, was occasioned as was proved upon investigation, by the brutal intemperance of the captain.

these temples of God. Questions of political expediency, exciting the public mind—whatever may be urged by the earnest reformers of these days, of their moral bearings—I am perfectly willing to leave to the occasions and places where they properly belong. For myself, I prefer on this holy day to speak of the great things of God's law, and the glorious things of the gospel of peace, and to meet you, my people, in the love of God, and the grace of the Lord Jesus, and the sweet fellowship of an holy spirit. With the course of public justice, also—whether in its progress or its issue—more especially when it is for the terror of the evil doer, and the punishment of the transgressor—I have not deemed it my duty (nor can I entertain any notions either of civil or religious liberty requiring me,) either as a citizen or a religious teacher, to interfere.

But when precious lives are in danger, and sacred interests of domestic, social affection exposed; when from the love of money, that fruitful source of evil, and that hastening to be rich, which marks us as a people, and in its various and complicated influence pierces with so many sorrows;—when by negligence, hazardous as it is unpardonable, blind as it is audacious; by the want of skill and faithfulness, which may bring with it all the *horrors*, without the *intention* of murder;—when by an insane rivalry, which has no earthly object but the gratification of an absurd vanity, and which to its own folly superadds the mischief of exciting by a contagious sympathy the like folly, the like insanity in multitudes whose lives are perilled by it—when by these and such like causes human life is sacrificed, and the hopes of kindred, families, the nation and even of mankind are blasted, then does it become every minister and every citizen, as God may give him light and opportunity, to speak: and may the same God give you of his own blessing to hear. May the cry go up to his holy place. May we as a people be saved from our sins, that we may be saved from his judgment, lest that may be fulfilled concerning us, which is spoken—'Madness is in their hearts while they live, and after that they go to the dead.'

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## *Minutes and Proceedings of the Institution of Civil Engineers, containing Abstracts of Papers, and of Conversation for the Sessions of* 1837.

(Continued from page 100.)

### May 2, 1837.

The President in the Chair.

The Ordnance Maps of England and Wales were received from the Master-General and Board of Ordnance, and the President announced that, by the munificence of Mrs. Chapman, the Institution was to be made the depository of all the professional plans and papers of the late William Chapman, of Newcastle.

Mr. Harrison presented a drawing of the Drops at South Shields, erected by himself, and gave an account of the method of working them.

Some remarks were made on the various methods which had been employed for representing the nature of a country as to levels and slopes. In one map of Warsaw the level of every point was shown; in the Ordnance maps of France the heights of most principal points above the level of the sea are noted. With respect to slopes, different degrees of shading might be used advantageously for mountain ground, the gentle inclinations being lightly and the steep places deeply shaded. In some Prussian maps they had represented mountain ground by circular lines at assigned distances, the lines being very near for considerable slopes. An objection to this plan is, that an engraver aims at a degree of accuracy which he can rarely arrive at; he cannot easily possess sufficient data to put the lines all round a mountain with any tolerable degree of accuracy.

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"On the Velocity of the Water in Belfast Harbour, by William Bald, Civil Engineer, F. R. S. E., M. R. I. A."

The Bay of Belfast, or Belfast Lough, is about eleven miles long by three broad, and has a depth of water varying from two to eight fathoms at low tide. The bottom consists of mud, and is an excellent holding ground. The mean of thirteen observations assigns the low-water line of spring tides, during the months of January and February last, at *two* feet above the sill of the gate of the new Graving Dock.

The waters of the river Laggan, fed by a basin whose area is 200 square miles, are discharged into Belfast Bay. The average quantity of rain annually is about 36 inches; assuming that *one-third* of this falls into the sea by the Laggan River, the quantity will be equal to *one foot* of depth over the whole basin. The mean daily quantity will be somewhat more than fifteen million cubic feet per day. This is the power combined with the tidal water to keep open the Channel of Belfast.

On a map accompanying this paper, are delineated the velocities of the ascending and descending currents at different states of the tide and parts of the channel.

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Mr. Harrison gave, at the request of the President, some information respecting the fuel and fire boxes of the locomotives on the Stanhope and Tyne Railway. From long experience they found that coal, which contains much bitumen, causes the tubes of the fire-boxes to leak in a very short time. They obtained coal as free from sulphur as possible, and the consequences had been most advantageous; for during two years and a half not more than 120 tubes had been required for seven engines, of which four were always at work. The tubes were of copper, and $1\frac{5}{8}$ inch in diameter. The usual speed about ten miles an hour. One engine weighing ten tons on six wheels takes 128 tons of coal. The consumption of fuel is $2\frac{1}{10}$ lbs. of coal per ton of goods per mile. The gross load is more than double the weight of the goods. The cheapness at which they carried was to be attributed to the low speed.

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Mr. Carneghie, in reply to a question from the President, stated that the Stone Planing Machine had not answered for sharp sand stone; but by endeavouring to imitate the mason's tool, and making the machine work in the same manner as the mason, they had succeeded completely. This tool was a comb with teeth, and curiously enough he had found in Dresden a tool which had been in use from time immemorial exactly similar to that which they had adopted.

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May 9, 1837.

The President in the Chair.

"On the application of Steam as a moving Power, considered especially with reference to the reported duties of the Cornish and other Engines. By G. H. Palmer, M. Inst. C. E."

In this paper Mr. Palmer first considers the maximum duty which can be done by atmospheric steam, and then, by reasoning analogically from certain theories, some of which are recognised as established, he infers that highly elastic steam, worked expansively, cannot be as economical as atmospheric steam. The reasoning by which the first question, namely, the amount of duty done, is treated, is as follows:—One bushel, that is 84 lbs. of coal, will convert 12 cubic feet of water into atmospheric steam, or each cubic foot of water is made to occupy 20,328 cubic feet. This may be applied directly to raise a column of water, say 35 feet high; that is, 84lbs. of coal will in the absence of all friction, be effective for raising 20,328 cubic feet of water 35 feet high; that is, 1,270,500 lbs. 35 feet high,or 44,573,375 one foot high. Making then the usual deduction of 4-10ths for friction, according to Tredgold's calculations, we have about 25,000,000 lbs. as the effective duty of the atmospheric steam produced by 84 lbs. of coal.

Mr. Palmer having ascertained the maximum duty of 84lbs. of coal, proceeds to infer that high pressure steam, worked expansively, must be less efficient than this; and the reasoning by which he arrives at this conclusion is founded on the following theories:—

1°. That the sum of the latent and sensible heat is a constant quantity.

2°. That all matter, steam of course included, evolves caloric on compression, and absorbs caloric on dilation.

3°. That equal quantities of water will always require equal quantities of fuel to convert it into atmospheric steam; but though equal weights of water must absorb equal increments of caloric when atmospheric steam is generated, it does not follow that all the caloric absorbed in high pressure steam is exclusively supplied by the fuel expended.

4°. That steam of two or more atmospheres elasticity does not contain two or more times the quantity of water contained in atmospheric steam, but contains proportionably as the pressure under which it is generated is increased.

"The preceding principles are illustrated, explained, and insisted on in great detail, and the author infers from them that the high pressure steam generated by one bushel of coal cannot, when worked expansively, perform more duty than atmospheric steam, unless, as is premised in the earlier part of the paper, more than 62½ lbs of water can be converted by 7 lbs. of coal from 40° Fahrenheit to atmospheric steam, and unless steam can dilate without converting sensible into latent caloric.

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*Novel Idea in Civil Engineering.*—It is proposed in the Board of Assistant Aldermen, of this city, to leave the question as to the *high bridge* or *syphon*, for crossing the Harlaem River, to the decision of the *electors* at the polls.

We are not informed whether these worthy gentlemen are about to decide what kind of cement or stone shall be used, by the same appeal to the public.

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*Reading Railroad.*—The Railroad between Reading and Norristown is completed, so that a complete line of communication between Philadelphia and Reading is now opened. The whole distance may be performed in less than four hours.

*Good Examples*, which should be universally followed for the good of the cause; and as we presume it is only necessary to mention them to insure imitation, we give the facts, withholding names, that others, *as well as ourselves*, may profit thereby.

We have recently, since the commencement of Vol. 7, received letters, or communications of congratulation on the reappearance of the Journal, from Chief Engineers of three important Railroads, in different parts of the Union, *each of which* contained the *advance* subscription for *five* or *six* subscribers, *mostly* new ones. If each Chief Engineer employed would *do likewise*, and each subscriber now indebted would pay up what he owes, we should be able to make the Journal more interesting, our creditors better satisfied, and ourselves better natured.

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## *Progress of Internal Improvements.*

We are always pleased to learn that there is competition and spirit amongst those who seek for contracts on public works; it encourages us to believe that the period is at hand when we shall again see operations resumed on all those works which have been suspended by the derangement of the currency, and many others commenced, which are essential to the convenience and prosperity of business.

The annexed notice of a "letting" on the "Central (Ga.) Railroad" is highly satisfactory—and we anticipate a speedy completion of this important work.

We shall give, in our next number, the first report of the Chief Engineer, L. O. Reynolds, Esq. The following notice is from the Savannah Georgian of 2d inst.

"*Central Railroad.*—Yesterday was the last day for receiving proposals for a further letting of this work.

"We are informed that contracts have been extended to a point 100 miles from the city—the distance put under contract yesterday being 21 miles.

"The contractors are all responsible men, and the prices rather below the estimate of the Engineer."

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We also find the annexed notice of the "Western and Atlantic Company," in the Georgia Pioneer, printed at Cassville, Ga., and ask the attention of Contractors to the advertisement of Col. Long, the Engineer, in this number of the Journal.

"We invite the attention of the public to the notice in reference to the Western and Atlantic Railroad, given in this number of the Pioneer.

"We rejoice to witness the rapid advancement of this magnificent enterprise—but a little more than a year has elapsed since the commencement of the surveys. At this time all the surveys requisite, in order to determine the most favorable localities for the road, from its southern terminus to the Tennessee line, have been made, and upwards of fifty miles of the road are now under contract, fifty miles more are again exposed for contracts, affording the unprecedented example of 100 miles of the same Railroad, offered for construction within six months from the date of commencing the work.

"The energy and despatch evinced by all engaged in this great enterprise are truly commendable; and no doubt can exist, that the plaudits of every patriotic citizen of Georgia, will be awarded to the Commissioners of the Railroad, for their zeal and efficiency in hastening forward its construction with such an unexampled speed.

"The times appear unusually auspicious for the vigorous prosecution of the work. The means available under the patronage of the State, are ample; the crops of the season already gathered, as well as those now ripening for harvest, were never more abundant and promising; and we are highly gratified to find a spirit and disposition on the part of those to whom the management of the Railroad has been entrusted, every way correspondent to the state of the times just adverted to."

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## *Georgia Railroad.*

We are indebted to a scientific friend for the following particulars of an important link in the great chain of Internal Improvement :–"This important work, but little known beyond the limits of Georgia, is destined to effect great changes in the direction of the channel of transportation between the Atlantic and some of the Western States. Those who are curious about such matters may trace its course on the map of the United States, by a line starting from Augusta and terminating at Tennessee river, a few miles above Rossville; passing through Crawfordville, Greensboro', Madison, Covington, Decatur and Marietta. The length of the road will be 280 miles, and throughout its whole extent, it is remarkable for its entire freedom from Inclined Planes, requiring stationary power for its easy grades and curves—at no point does the rise exceed 35 feet per mile. Between Augusta and the Atlantic, there is (in operation) an excellent Railroad to Charleston, and as fine a river for steamboat navigation as the Mississippi itself to Savannah. At the other end of the road, there is a river navigable for steamboats up to Knoxville; and a Railroad is being built to the same place, which will leave the Georgia Railroad near the State line. The Tennessee river below the termination is navigable for steamboats to the Mississippi, with the single exception at the Muscle Shoals, around which there is now in operation a Railroad on the south side of the river, and a canal is in progress of completion on the north side.

By the Georgia Railroad, merchandize may be delivered from Philadelphia or New York on the Tennessee river at $1 to $1 20 per 100 lbs. in the space of 6 to 10 days.

That portion of the work between Augusta and Decatur, is to be constructed by the Georgia Railroad and Banking Company. Sixty-five miles of it is now finished, and 83 miles reaching to Greensboro' will be completed in December—the balance as early as possible.

Beyond Decatur the work has been undertaken by the State of Georgia, and it is progressing with great rapidity—upwards of 50 miles of it is now under contract, and every arrangement has been made to complete the whole line by 1841.

In connexion with the Georgia Rail-road, there is a branch railroad (to convey the travel between the North and South,) to diverge at Covington and run to West Point, there intersecting the Railroad from thence to Montgomery, now being constructed. Thus completing an entire chain of Railroad and Steamboat communication between New Orleans and the North. View the Georgia Railroad in all its bearings, it will be considered the most important improvement now in progress." —*U. S. Gnzette.*

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*Central (Ga) Railroad.*—We find in the Savannah Georgian, of July 28th, the following notice of this Road:—

"The road bed is graded to the extent of 72 miles. The rails are laid 35 miles, the cars running that distance, and the Macon mail and passengers are now carried 30 miles on the road. This shortens the time between this city and Macon about 4 hours; a connexion with the stage line will be made in a few days, 10 miles further up. The contractor for laying superstructure is pushing on with a heavy force at the rate of about 1½ mile per week.

"The grading is under contract to a point 79 miles from this city, and on Wednesday of next week, contracts will be extended to 100 miles, and the road will be graded that distance by the 1st of January next.

"The force on the line is now about 400 men. Two parties of Engineers are actively engaged in defining the line from Ogechee onward, and the result of their surveys shews a more favorable route than was originally calculated on.

"The inhabitants of Burke county are awakening to the importance of a connexion by means of a branch between our road and Augusta, *via* Waynesborough—and if we may be permitted to express an opinion on this subject, we have no hesitation in saying that no Railroad project in the State offers a fairer promise of profit than this branch. A public meeting is called at Waynesborough, on the first Monday in August, to deliberate on the subject. We say, 'God speed them in the good work.'"

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*Liberal and successful Legislation.*—The annexed communication, signed X, is from the Boston Daily Advertiser; it shows what may be effected by liberal, yet judicious legislation.

"*Western Railroad.*—We understand that the Stock created at the last session, so far as it has reached London, has been sold at 3 and 4 per cent. advance, principally at 4 per cent. advance. This, added to the premium of the Exchange on London, will make an aggregate of 11 per cent.; which (agreeably to the provisions of the Act,) are to constitute a Sinking Fund and to be paid as such, into the hands of the Treasurer of the Commonwealth.

"This Sinking Fund, augmented every year, by its accruing interest and by 1 per cent. on the whole loan of $2,100,000, to be paid annually, by the Western Railroad, to the Treasurer of the Commonwealth, *will be more than sufficient to pay off the whole amount of the loan,* by the time it becomes due.

"Thus will the Legislature of Massachusetts of 1838, have caused the Western Railroad to be built, in the shortest possible time;—have occupied usefully, a great mass of idle labor; and have created, by their skill, a great proportion of the funds to accomplish this great enterprise; and have done all this without any expense or risk to the State.

"Thus, also, will they have contributed their share to the great mass of State Stocks, which (created by various States, for Internal Improvements,) has so usefully aided each and all of them, to obtain tangible funds, for the resumption of specie payments.

"In the history of that most important instrument for the happiness of man, (Internal Improvement) the Legislature of Massachusetts, for 1838, will hold a distinguished place, as having given life to a measure calculated to do immense good, in its present and in its future consequences—both in peace and war—without cost of blood or treasure; and as having revived the benumbed energies of the great State of Massachusetts, and penetrated, for the benefit of the present and future generations, the very heart of the fertile and immense valley of the Mississippi. X."

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*Railroad Contracts.*—We understand, says the Columbia (S. C.) Telescope of the 21st inst. that on the recent visit to this place of the President and chief engineer of the Louisville, Cincinnati and Charleston Railroad Company, they succeeded in making contracts for the construction of the remaining portions of the road from Columbia to Charleston, extending from McCord's Ferry, on the Congaree, to Branchville, a distance of about 40 miles, at rates at or below the estimates of the engineers. When the first contracts were offered on this road, there was very little competition and few bidders. But with the progress of the work, has sprung up a spirit, which promises to carry it through with a becoming zeal and energy. Our planters are coming forward and taking contracts on the most satisfactory terms. It has been demonstrated that our slaves are well calculated for this description of work--furnishing a species of labor which can be advantageously employed at all seasons of the year, and to any amount the wants of the company may require. We congratulate the country upon the cheering prospects and bright hopes which this great work continues to hold out to the people of the Southern and Western States—hopes which we trust are destined to be fully realized.

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*Our Great Railroad.*—At a meeting of a number of the Stockholders in the Cincinnati and Charleston Railroad, at this place on Friday last, (says the Knoxville Register, of the 11th inst.) resolutions were unanimously adopted requesting the Directors from this State to make immediate application to the President, for a corps of Engineers, to make a final survey of the route between this place and the North Carolina line, preparatory to its definite location, and putting under contract; and also requesting the location of a branch of the South Western Bank at this place, at as early a day as practicable. The meeting then adjourned to meet again at this place on the first Tuesday, 7th day of August next. The object of this adjourned meeting is that the Stockholders in Tennessee may deliberate and instruct their Directors upon an early commencement of the work in Tennessee. A general meeting of the Directors takes place in September, and if our local Directors request it, immediate steps will be taken to commence the construction of the Road in Tennessee. This is an important question, and we trust our Stockholders will generally attend the meeting in August.—*Ch. Patriot.*

"*Railroad Bridge Burnt.*—The bridge on the Schenectady and Utica Railroad, four or five miles east of Fonda, was burnt on Friday night last, in consequence of which the train of Saturday morning was delayed. It was supposed to be the result of villainy."

It is hardly to be anticipated that a system, which affords so much benefit to the community, can escape the malice of *envy* and *ignorance.*

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### *Locomotive Steam Engines.*

We would call the attention of such of our readers as are interested in Railroads, to the communication of Mr. W. Baldwin, of Philadelphia, the most extensive manufacturer of Locomotive Engines in the country.

By a reference to the testimonials annexed to his card, it will be seen that they are *official certificates* of the every day performance of his Engines *for years*, and not a description of a single performance.

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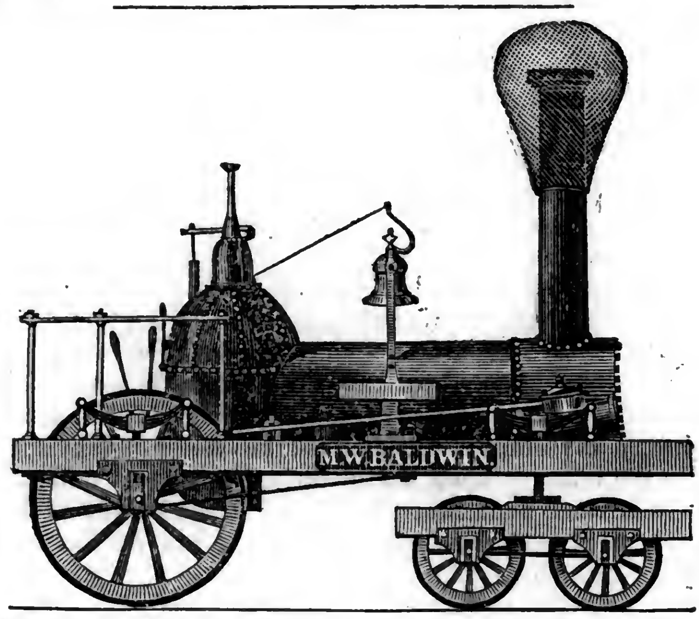

From the annexed testimonials, it will be seen that the Engines of M. W. B., are not inferior in capacity of performance to any Engines in this, or any other country; while at the same time they combine several improvements secured by patent, and many advantages not to be found in other Engines.

One very important advantage is, the simplicity of their construction and arrangement, by which every part of the machinery is perfectly accessible while the engine stands upon the road.

The improvement in the construction of the cranks is one of *great importance*, obviating the liability to break,—an occurrence so common to most locomotive engines.

Another great advantage arises from having the fire-box before the driving wheels, thus making an equal distribution of weight, which wholly corrects the galloping or undulating motion peculiar to both 4 and 6 wheel engines, with the fire-box behind the driving shaft, making them more easy upon the road than any engines of the same capacity now in use; while, by the very simple device of throwing a portion of the weight of the tender upon the driving wheels, or detaching it at pleasure, the engine is made to possess the advantage of a light, with the adhesion of a heavy engine upon the ascents where increased adhesion is required.

In order to test their comparative merits, when used on the same roads with other engines, he suggests that a regular account be kept, of expenses of repairs, distance travelled, and work performed by each engine; which will furnish the only correct data by which to judge of their respective merits, which cannot be correctly done by a few experiments made for the purpose of effect.

M. W. B. manufactures three classes of Engines, Nos. 1, 2, and 3. Most of the above engines belong to the 3d, or smaller class, and many of them have been in use from two to four years. His present engines are very much improved. One of the first class, recently built, has drawn over the Columbia road, part of which has an ascending grade of 45 feet per mile, 35 loaded cars weighing 187 tons, equal to about 700 tons on a level.

Orders for engines or machinery promptly executed, on application to M. W. BALDWIN, Philadelphia, or to E. L. MILLER, his agent, for contracts in the city of New York.

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The following testimonials of the merits of these engines, have been received from Officers, Engineers, and Superintendents of motive power, &c. &c. of several of the roads above referred to.

Mr. John Brandt, Superintendent of Engines and Machinery, on the Columbia and Philadelphia Railroad, writes under date of the 11th of May, 1338:—"We have twenty-four of your engines, several of which have been in use since the fall of 1834. Two of your 3d class engines commenced running Feb. 22d, 1837, and travelled 55,6?5 miles, up to the 1st of May, 1838, and cost for repairs during the above-mentioned time, one cent and eight mills per mile. Eight engines of the first class, have travelled from the 1st of January, 1838, to the 1st of May, (4 months) 46,569 miles, made 653 trips, drawing 16,836 cars; the cost per mile for these four months, I am now unable to show, as our books are not posted, but can assure you that the expenses this year will be less per mile than any former years. One of the first class recently built, has drawn over the Columbia road, part of which has an ascending grade of 45 feet per mile, 35 loaded cars, weighing 187 tons, equal to about 700 tons on a level, and travelled from 8 to 12 miles per hour, except on the wooden track. This is the heaviest train that has ever passed over the road."

James T. Shipman, Resident Engineer of the Long Island Railroad Company, writes May 21st, 1838: "We have two engines of class No. 3, of your manufacture, which have been in use since May, 1836. Their performance is worthy of the most unqualified praise. We carry as an ordinary load, 15 freight cars, weighing 5½ tons each; and to show their efficiency, we have frequently taken 20 cars without difficulty, up an ascent of 35 feet to the mile; and have carried 4 cars up a grade of 211 feet per mile for a distance of 2,100 feet. The average speed for freight is 10 miles, and for passengers, from 20 to 25 miles per hour. In the summer of 1837, they performed the distance of 162 miles each day, and from the journal which now lies before me, it appears that under this severe usage, there was no failure in either of these engines for 6 months, which rendered a change in their usual time of running necessary, or caused any delay, either in the transportation of passengers or freight. I am fully satisfied that the cost of repairs does not exceed one half that of a four wheel engine doing the same work."

Mr. John Cash, superintendent of motive power, on the Norristown Railroad, says under date of May, 1838: "I take great pleasure in bearing testimony to the excellence of your engines They are well adapted to light or heavy loads. With one of the small class which has been nearly three years in constant service, I have drawn a train of 750 passengers, over grades of 32 feet per mile, at the rate of 14 miles per hour."

Mr. J. Elliot, Superintendent of Motive power, on the Philadelphia, Wilmington, and Baltimore Railroad, writes: "After an experience of several years with Locomotive engines on different roads, I am of opinion that the engines of M. W. Baldwin, are easier upon the road than any engines in use, and that they combine more advantages than any locomotives within my knowledge. They have been almost constantly running for the last eighteen months. The engine Brandywine, has been running 265 days, at a cost for repairs of $65 17, and has lost but 5 days since she was put on the road. The Christiana has been running 135 days at a cost of but $20 for repairs. Their average speed is 24 miles per hour, including stoppages."

L. G. Cannon, President, and L. R. Sargent, superintendent of the Rensselaer and Saratoga Railroad Company, say under date of 29th of May, 1838: "We have two of your locomotives which have been in use about three years. They *work well* in every particular; and I deem it but an act of justice to say that the manufacture and materials of each have proved to be of the highest order, and I have evidence from the official reports of other companies, and my own experience here, that your engines will, in *performance* and *cost of repairs*, bear comparison with any engines made in this, or any other country."

W. W. Woolsey, Esq. President of the Boston and Providence Railroad Company, writes on the 31st of May, 1838: "We have three of your Engines, which have been in use since about June, 1836. We have never had occasion to put them to their maximum capacity. They have carried 17 freight cars of gross weight, say 85 tons, engine and tender not included, over the road at an average speed of 10 miles per hour, including an ascent of 5 miles in length, one half mile of which is 42½ feet per mile, and the remaining four and a half miles. 37½ feet per mile. They carry ten passenger, and three baggage cars, *very easily* over the road, at an average speed of 18 or 20 miles per hour. Your engines give *entire satisfaction.*"

From Wm. C. Young, Superintendent and Engineer of the Utica and Schenectady Railroad, May 22d, 1838: "The twelve locomotive engines procured of you for the Utica and Schenectady Railroad have answered their purposes effectively. Notwithstanding much has been said about improvements in such machines, I have not been able to satisfy myself that ours are wanting in any particular."

J. Edgar Thompson, Chief Engineer, and General Agent of the Georgia R. R. & B. Co. writes July, 1838: "We have in operation on the Georgia Railroad, six locomotives from Mr. Baldwin's factory, all of which have given us entire satisfaction. The simplicity of their construction, and the excellent proportions and arrangement of the various parts of the machinery, entitle them in my opinion, to a decided preference over any other engines that I have examined, either of European, or domestic manufacture."

H. R. Campbell, Esq. Civil Engineer of Philadelphia, writes: "One of your third class Engines (the West Chester) this morning, (June 8th) drew a train of *fifty-one* loaded cars, from Schuylkill Bridge to Broad street, (4 miles) passing several abrupt caves, some of 757 feet radius, and several ascending grades, one of which is 32 feet per mile. The weight which I got from the weighmaster of the road, for my own satisfaction, was 284½ tons exclusive of the Engine. It exceeds any experiment I ever heard of in any part of the world, and was apparently made without any preparation, for no one was present to witness it, but the hands on the road and myself, who was casually passing."

L. A. Sykes, Esq, Superintending Engineer of the New-Jersey Railroad, says under date of June 12th, 1838: "We have five of Mr. Baldwin's third class Engines on our road, which have been in use from one to two and a half years, and have performed to our entire satisfaction. Our first Engine was put upon the road in December, 1835; it has been in constant use with the exception of a very few days; is now in perfect order, and apparently as good as ever. In simplicity of construction, small liability to get out of order, economy of repairs, and ease to the road, I fully believe that Mr. Baldwin's Engines stand unrivalled. I consider the simplicity of the Engine, the arrangement of the working parts, and the distribution of the weight, far superior to any thing I have ever seen, either of American or English manufacture, and I have now no hesitation in saying, that Baldwin's Engines will do the same amount of work, with much less repairs, either to the Engine *or the track*, than any other engines now in use."

# AMERICAN RAILROAD JOURNAL, AND MECHANICS' MAGAZINE.

No. 5, Vol. I. New Series. | September 1, 1838. | Whole No. 317. Vol. VII.


## *Remarks on the Velocity of Steam Vessels.*

To the Editors of the Railroad Journal.

*Barnwell District, South Carolina, July* 1, 1837.

Gentlemen,—In Renwick's Treatise on the Steam Engine, page 264, I find the following statements:—

"To determine the velocity that a given engine will give to a vessel, and the conditions under which it may produce a maximum of effect, is evidently a problem of great complexity. We do not conceive that it has ever been solved in a manner perfectly satisfactory either in theory or practice."

"Even the simplest point concerned in the investigation, namely, the velocity of the wheel through the water, at which a maximum effect would be produced, does not appear to have been solved."

The author then goes on to state that the velocity of the wheel should be to that of the water as 4 to 3, and cites the theorem of Parent. At page 268, alluding to the steamboat North America, he says—"The relation between the velocities of the boat and the wheel is as 3 to 4, or identical with that chosen by us as the most advantageous." And at page 275 he gives this practical rule—"The relative velocity of the circumference of the wheel, should be, in all cases, six and a half feet per second."

As these rules appear to be at variance with each other, and are given without demonstration, I have been induced to offer you the following theory.

A boat in motion is resisted by the water, by the air, and by gravity on the inclined plane of a rapid current. If we denote the area of the immersed parts of the midship section of the vessel in square feet, by $b$, and the velocity of the boat through the water, by $v$, then the resistance of the water to the motion may be expressed by $b\,h\,v^m$, in which $h$ is a co-efficient to be determined by experiment. If the velocity of the current be represented by $r$, the absolute velocity of the boat will be $v \pm r$; also, if the velocity of wind, either in favor or opposition of the motion, be $w$, then the motion of the boat through the air will be $v \pm r \pm w$; and the resistance of the air will be $\pm c\,k\,(v \pm r \pm w)^m$, in which $c$ is the area of the surfaces exposed to the action of the air; and if the total weight of the boat in pounds be M, and the inclination of the plane $i$, the resistance from this cause will be expressed by $\pm$ M sine $i$. The total resistance to motion of the boat will, therefore, be $b\,h\,v^m \pm c\,k\,(v \pm r \pm w)^m \pm M \sin. i$.

Let, now, the rotary velocity of the paddle be represented by V, and it will strike the water with the velocity $V-v$; and if $a$ denote the area of paddle, the resistance of the water to the motion of the paddle will be $af(V-v)^m$. But it is a known principle in mechanics, that for a body to be in a state of uniform motion, the accelerating force must be equal to the resistance. The reaction of the water against the wheels must, therefore, be equal to the resistance of the boat; which gives us this equation:

$$af(V-v)^m = b\,h\,v^m \pm c\,k\,(v \pm r \pm w)^m \pm M \sin i \ldots\ldots\ldots\ldots \text{(I)}$$

which solved for V, gives:

$$V = v + \sqrt[m]{\left\{\frac{bh}{af}v^m \pm \frac{ck}{af}(v \pm r \pm w)^m \pm \frac{M \sin i}{af}\right\}} \ldots\text{(II)}$$

But the power required is evidently equal to the resistance on the wheels multiplied by their velocity, that is Q = resistance $\times$ V, substituting for V its value in equation (II), and for the resistance the second member of equation (I), and we obtain

$$Q = b\,h\,v^{m+1} \pm c\,k\,v\,(v \pm r \pm w)^m \pm M\,v \sin i + \sqrt[m]{\left\{\frac{bhv^m \pm ck(v \pm r \pm w)^m \pm M \sin i)^{m+1}}{af}\right\}} \ldots\ldots\text{(III)}$$

By far the most useful case of this equation is that in which the resistance of the air and the slope of the current are not considered. In this case the equations become—

$$af(V-v)^m = b\,h\,v^m \ldots\ldots\ldots\ldots\ldots\ldots \text{(IV)}$$

$$V = v\left(1 + \sqrt[m]{\frac{bh}{af}}\right) \ldots\ldots\ldots\ldots\ldots\ldots \text{(V)}$$

$$Q = bhv^{m+1}\left(1 + \sqrt[m]{\frac{bh}{ap}}\right) \ldots\ldots\ldots\ldots \text{(VI)}$$

from which last,

$$v = \sqrt[m+1]{\frac{Q}{bh\left(1 + \sqrt[m]{\frac{bh}{af}}\right)}} \ldots\ldots\ldots\ldots \text{(VII)}$$

In equations (III) and (VI) we see that $a$ occurs only in the denominator which shows that *the greater the area of the paddle the less the power required.* If $a = o$ the power becomes infinite; while if $a$ be made infinite, equation (VI) reduces to $Q = bhv^{m+1}$; and equations (II) and (V) to $V = v$. This would be the case if the wheels wound up two ropes extending down the river.

The power of a steam engine is not constant but varies with the velocity of its piston, and as the velocity of the piston varies with that of the wheel, our power Q will also vary with the velocity of the boat, and this renders an additional investigation necessary. We shall first proceed to find the maximum velocity of a boat with a given cylinder and pressure of steam.

Representing the total pressure of the steam in pounds per square foot, by $s$ and the pressure of the atmosphere, or the vapor in the condenser, according as the engine condenses or not, by $e$, and the effective pressure will be $s-e$. The friction of the engine will be proportional to the pressure on the rubbing parts, or as $s-e$, and may be expressed by $Z\,(s-e)$, and the available power will be $(s-e)(1-Z)$, which we may write $z(s-e)$. The area of the cylinder whose diameter is $d$, is $\frac{\pi}{4}d^2$, and consequently the effective force on the piston will be $\frac{\pi}{4}d^2 z(s-e)$. This force in its application to the paddle is still further diminished in the ratio that the velocity of wheels has to that of the piston, *i. e.*, D being the diameter of the wheels, and $l$ the length of the stroke, as $\pi D$ to $2l$, the force on the wheel will then be $\frac{\pi}{4}d^2 z(s-e)\frac{2l}{\pi D}$ which is equal to $\frac{d^2 lz}{2D}(s-e)$; and for the motion to be uniform, this must be equal to the resistance of the wheel, which we have seen is equal to $bhv^m$; whence we have this equation $\frac{d^2 lz}{2D}(s-e) = bhv^m$, which gives:

$$v = \sqrt[m]{\left\{\frac{d^2 lz}{2Dbh}(s-e)\right\}} \ldots\ldots\ldots\ldots\ldots\ldots (\text{VIII})$$

This will be the velocity, supposing that the boiler can furnish the requisite quantity of steam, and that it can pass through the pipes with sufficient velocity. Let us see what is this quantity of steam. The velocity of the piston is $\frac{2l}{\pi D}V$; substituting for V its value from equation (V) and this becomes $\frac{2l}{\pi D}v\left(1+\sqrt[m]{\frac{bh}{af}}\right)$ this multiplied by the area of the piston, $\frac{\pi}{4}d^2$, gives for the volume of steam that must enter the cylinder, $\frac{d^2 l}{2D}v\left(1+\sqrt[m]{\frac{bh}{af}}\right) = Wy$; in which W is the quantity of water evaporated per second, and $y$ the volume of the steam corresponding to the given pressure. By substituting for $v$ its value from equation (VIII) this becomes—

$$Wy = \frac{d^2 l}{2D}\left(1+\sqrt[m]{\frac{bh}{af}}\right)\sqrt[m]{\left\{\frac{d^2 lz}{2Dbh}(s-e)\right\}} \ldots (\text{IX})$$

There is no necessity for the boiler to make more steam than this, for it cannot enter the cylinder, but must blow off by the safety valve.

But if the boiler should not furnish steam enough for this velocity, it will expand in the cylinder, which will diminish its pressure, and this diminished pressure must be used in the equation in place of $s$, to determine the true velocity. The pressure in the boiler will be to that in the cylinder as the volume used by the cylinder is to that furnished by the boiler, that is, as $\frac{d^2 l}{2D}v\left(1+\sqrt[m]{\frac{bh}{af}}\right) : Wy$. The pressure in cylinder will therefore be $\frac{2DWys}{d^2 lv\left(1+\sqrt[m]{\frac{bh}{af}}\right)}$ this substituted for $s$ in equation (VIII) gives—

$$v = \sqrt[m]{\left\{\frac{d^2 lz}{2Dbh}\left(\frac{2DWys}{d^2 lv\left(1+\sqrt[m]{\frac{bh}{af}}\right)}-e\right)\right\}} = \sqrt[m]{\left\{\frac{Wyzs}{bhv\left(1+\sqrt[m]{\frac{bh}{af}}\right)} - \frac{d^2 lze}{2Dbh}\right\}}$$

from which $v^{m+1} + \frac{d^2 lze}{2Dbh}v = \frac{Wyzs}{bh\left(1+\sqrt[m]{\frac{bh}{af}}\right)} \ldots (\text{X})$

An equation which when solved for $v$ will give the velocity, subject however to the condition above-mentioned, that W $y$ must not be greater than

$$\frac{d^2\, l}{2\,D}\left(1+\sqrt[m]{\frac{bh}{af}}\right)\sqrt[m]{\left\{\frac{d^2\, l\, z}{2D\, bh}(s-e)\right\}}$$

Q is expressed in pounds raised one foot per second, and as a horse power is 33,000 lbs. raised one foot per minute; to get the value of Q, we must multiply the horse power of the engine by 550.

If the resistance of the water be as the square of the velocity, $m = 2$ and by equation (VI) Q will be as the cube of the velocity, but Q is the power expended in the unit of time, the total power in any time $t$ will be $t$ Q. But the time of performing a given distance $s$ through the water is $\frac{s}{v}$, which gives $t\,Q = \frac{s}{v}\,Q$, but as Q is as the cube of the velocity, the expenditure of power will be as $\frac{s}{v}v^3$, or as $s v^2$, as the square of the velocity. In ascending against a current whose velocity is $r$, the time required to ascend a given distance, is $\frac{s}{v-r}$ which makes the power $t$Q be as $s\frac{v^3}{v-r}$ which is easily shown to be a minimum when $v = \frac{3}{2}\,r$, but as the boat will steam in the downward trip, the time of ascending and descending will be $\frac{s}{v-r} + \frac{s}{v+r} = 2\,s\frac{v}{v^2-r^2}$, and the power will be as $2\,s\frac{v^4}{v^2-r^2}$ which is a minimum when $v = r\sqrt{2}$.

We have spoken of the velocity of the paddle, when in reality every part moves with a different velocity, for the outer edge evidently moves faster than the inner, which is nearer to the centre, but a certain point can be found whose velocity is such that if the whole paddle moved with that velocity, the action would be the same as that of the actual paddle; we propose to call this point the centre of resistance, as we do not find that it has been taken notice of by writers.

If we represent the velocity of the outer edge of the paddle by $y$, the distance of any point from the axis by $x$, and the radius of the wheel by $a$, the velocity of the point $x$ will be $y\frac{x}{a}$, and the point $x$ will strike the water with the velocity $y\frac{x}{a} - v$, which by making $n = \frac{v}{y}$, may be written $y\left[\frac{x}{a} - n\right]$. The action of any element of the paddle $d\,x$ will therefore be, as $\left[\frac{x}{a} - n\right]^2 d\,x$, and the whole action of the paddle will be F$\left[\frac{x}{a} - n\right]^2 d\,x$, which between the limits $x = a-b$, and $x = a$ (in which $b$ is depth of paddle, gives) $\frac{a}{3}\left\{(1-n)^3 - \left[(1-n) - \frac{b}{a}\right]^3\right\}$ for the whole action of the paddle, which is equal to $(1-n)^2\, b - (1-n)\frac{b^2}{a} + \frac{b^3}{3\,a^2}$.

Now taking $c$ for the distance of the centre of resistance from the axis, the velocity of that point will be $\frac{c}{a}y$, and if the whole paddle moved with that velocity the action would be as $b\left[\frac{c}{a} - n\right]^2$, whence, $b\left[\frac{c}{a} - n\right]^2 = (1-n)^2 b - (1-n)\frac{b^2}{a} + \frac{b^3}{3\,a^2}$, from which $c = a\,n + \sqrt{\left\{(1-n)^2\, a^2 - (1-n)\,a\,b + \frac{b^2}{3}.\right\}}$

This equation will serve to find $c$, when the velocity of the circumference of the wheel $y$ is known. Our equations (II) and (V) give the velocity V of the point $c$ itself; in this case to find $c$, we must consider that the velocity of $c$, namely : V is to that of the circumference $y$ as $c$ to $a$, or $y = \frac{a}{c}$ V, and as $n = \frac{v}{y}$, $n = c\frac{v}{aV} = cm$. By substituting this value of $n$ in our equation for $c$, we shall find $c$ by solving a quadratic. In all the equations the diameter of the wheel, D, must be taken as $2c$, not the actual diameter from out to out; it will generally be sufficiently near to measure from the middle of the paddles.

It is evident from equation (VIII) that if a boat working at full pressure in the cylinder, were to take three similar boats in tow, the velocity would be reduced to one-half, while from equation (VII), if the power of the engine remained constant, it would take seven other boats to reduce the velocity to one-half; the reason of this difference is, that in the first case a great part of the steam would escape, not being able to enter the cylinder, and from this it follows that a tow boat should never work at full pressure, or the steam will be wasted when most needed.

All our measures are given in feet, and the velocities in feet per second, also the pressures are expressed in pounds per square foot, and the water evaporated in cubic feet per second.

I have found that these equations answer, by making $f = 1{\cdot}943$; $h = {\cdot}108$, for a good model; $m = 2$; $k = {\cdot}002$; and $z = \frac{5}{6}$.

E. C. Bellinger.

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(From the Journal of Commerce.)

## *The New Steam Boat Law.*

We will go as far as any one in support of any *practicable* measure for the greater security of life on board of steamboats; while on the other hand it is evident, that any measure which only *seems* to promote that result, but does not in fact do so, is an injury both to steam-boat proprietors and the public. It is an injury to the former, inasmuch as it causes them trouble and expense; and to the latter, inasmuch as it begets, if trusted in, a misplaced confidence, which endangers life instead of protecting it.

In this light we regard the new Steam Boat law; at least that portion of it on which most people not conversant with the structure of steam-boats and machinery, will be apt to place their chief reliance. The provisions which require iron rods or chains instead of tiller ropes,—a suction hose and engine,—a suitable number of small boats,—and signal lights at night,—are reasonable and practicable.* So would have been a provision requiring each boat to be supplied with a number of life-preservers, equal to the usual number of passengers. But these are only incidentals. The prominent features of the bill are, 1. That which provides for a system of inspection; and 2. That which makes the proprietor of a steamboat responsible for all injuries which may occur to persons or property on board of the same, by reason of explosions or other

* Yet the phraseology indicates that the framers of the law were not much conversant with the subject upon which they were legislating. Do they mean that iron rods or chains shall extend to and pass around the wheel? That would be attended with great difficulty, to say the least. And as to signal lights, there are much better and more efficient regulations now in force in this part of the country, under State laws, than are required by the Act of Congress.

irregular escape of steam, unless he can *prove* "that no negligence has been committed by him or those in his employ."

In regard to the first of these provisions, we remark, that, however well it may look on paper, it will in practice *deceive* the public, instead of enlightening them. Who are to be the inspectors? Admitting that they will be, as the laws declare they shall be, "skilled and competent" men; we ask who is so skilled and competent, as by devoting $5 worth of his valuable time to a glance over the boiler and machinery of a steam-boat, to be able to judge of its strength and safety with *any thing like* the accuracy of the engineer, who has had it under his immediate inspection for months and years, and knows every inch of its surface, and every point of imperfection, if any exist, as well as man can know it? Again, what stranger is, or can be so deeply interested in having a safe boiler and sound machinery in any particular boat, as the engineer himself, who knows that in case of an explosion, or other disaster, he, from his position will be among the most certain victims. He has at stake not only his business, but his reputation, and his life. Who has more? Not surely the man who pockets his $5, and has no further interest in the result than his humanity may impart; for of course, if, afer *his* inspection, the boat should blow up it would be owing to the negligence, ignorance, or imprudence, of the engineer or his subordinates. One thing however, the inspectors may ascertain, and post up in some conspicuous place on board, to frighten or afford false confidence to the passengers; and that is, the *age of the boiler!* yes, and the *age of the boat* too!! Of all the ridiculous nonsense that ever was thought of to humbug the public, this the most arrant. Who does not know that the age of a boiler, or of a boat, is no test, nor scarcely any indication, of the strength and safety of either? Some boats are more seaworthy at the age of ten years than others at one; and the same is true of boilers. Why are not the inspectors required to post up also the fact whether the boilers are of iron or copper? In that case, how many poor creatures would be frightened out of their wits to find themselves on board of a boat with an iron boiler! while on the other hand, if they should read on the inspector's broad sheet that the boat had a copper boiler, they would throw away their life-preservers and sit on the safety valves. And yet, as a mattter of fact, the iron boiler is stronger and safer than the copper one. All the interests of the owners, engineers, firemen, and others, concerned in the running of a steamboat, are deeply involved in her safety. And yet they *may* err,—as was most disastrously illustrated in the case of Mr. G. B. Lamar, owner of the Pulaski, who entrusted himself and his whole family and much of his property on board of her on the voyage which was her last. Who that is human, is not liable to err? Is the $5 inspector the only exception?

Then as to damages in case of an explosion. The law makes the owners responsible for it all, whether of life or of property [what is the value, in dollars and cents of a life?] unless they can prove there has been no negligence. But, how can they expect to prove this? The engineer and firemen are probably dead, and there is no other being on earth who has any knowledge on the subject. Passengers may *guess* there has been negligence, as in the case of the Pulaski, and almost every other case of disaster,—for surely, if all was right, why should there be an explosion? The explosion itself is made by the law *prima facie* evidence of negligence; the few persons who, if living, could have disproved this false testimony, are dead; and the passengers, as usual, concur in the opinion that there *must have been* negligence. And so the owners, as innocent as the spot-less robes of light, and having used every reasonable and proper precaution to secure the safety of their passengers and crew, are mulcted in a sum equal to the full value of the property on board (sometimes half a million dollars) and also in the full value of all the lives lost, besides suffering the partial or total loss of their boat, and probably some of their near friends. And all this because they cannot disprove the *prima facie* evidence which the law arbitrarily establishes as real evidence, when it is on evidence at all. If this is not injustice, we should like to know what is.

The Act under consideration, besides being in the nature of an ex-post-facto law, affecting vast amounts of property invested under the idea that steam-boating was a lawful pursuit, is still further objectionable, inasmuch as it will have a tendency to drive responsible men out of the business, and throw it into the hands of adventurers. It will also operate as a formidable barrier to prevent any of the steamboats which are to ply between the United States and Europe, from being owned in this country, or bearing the American flag.

The law proceeds upon the following assumptions, which have been anything but proved :

1. That boilers and boats which have been some time in use, are much more liable to accidents than new ones.

2. That the Inspectors can have a better knowledge of the trustworthiness of a boat, boiler and machinery, and stronger motives to prevent disasters, than they who are immediately interested.

3. That the accidents which have occured hitherto, have arisen from the inattention and recklessness of those concerned, when the facts, so far as known at all, at least in regard to cases which have occurred in the Atlantic States, would show the contrary to be the fact, and the blame, if any, to lie in other quarters.

To us it appears obvious. that a thorough official investigation into the causes and circumstances of each accident, and the publication of all the facts and evidence elicited, which course has never yet been pursued, save in one or two instances, would do more to obviate the true cause of these disasters, than all the blindfold penal legislation that can be devised,—even if the rack and gibbet were to be superadded.

We heartily coincide, with a single exception, with the opinions expressed in the above article respecting the law in question. With regard to the inspection of boats and engines, we consider it a matter of moonshine, for no man can decide, with any chance of certainty, on the safety of a boat or engine, from such an inspection as he can afford to make for five dollars. Few men can be found capable of making the inspection at all, but many can be found in every place willing to accept of such an appointment as a sinecure. But whatever may be the talents or qualifications of the inspector, if he gives favorable certificates, and any disaster happens, ten chances to one, the owners, who perhaps may be models of innocence, are ruined. It has been held as a primary principle of law in our country, that every man is presumed innocent till proved guilty—but in this law the case is reversed. An accident happens, which perhaps no foresight could have avoided, by which lives are lost, perhaps every person on board—the owners, who are honestly serving and accommodating the public, are by this law at once declared manslaughterers; the burden of proof is shifted on them, and they must suffer accordingly, unless they can prove their innocence when the witnesses are every soul dead.

With respect to the chain, &c. we should say the writer manifests the same ignorance of the subject which he imputes to the legislators. If he were acquainted with practical mechanics, he would know that a chain is as applicable to a wheel, or pulley, as a rope.

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## *Eastern Railroad Opening.*

We copy the annexed notice of the opening of the Eastern Railroad from the Yankee Farmer, of Saturday. It adds another important link to the "great Atlantic chain," upon which we have so long labored.

"Agreeably to previous notice the Eastern Railroad was opened as far as Salem, on Monday last, Aug. 27. In the morning the cars started from Salem with the proprietors and invited guests from that place, and arrived in Boston at about half past 12 o'clock, P. M. The cars started on their return with the addition of other proprietors and invited guests, numbering upwards of 500, and arrived at Salem, stopping at Lynn, at about half past 1 o'clock, P. M. Owing to the crowded state of the cars both from Salem and Boston, the stockholders from Lynn could not be accommodated, and a separate train of cars was despatched from Salem for them.

"On the arrival of the train from Lynn, the company, numbering nearly 1000, formed in procession and proceeded to the depot, where a collation was provided in a building nearly two hundred feet in length, and sufficiently wide to accommodate four tables. The Hon. L. Salstonstall, Mayor of Salem, presided, and after the eatables were duly disposed of, made a brief address, stating the history of the enterprise and some of the circumstances attending its completion hitherto. He gave as a toast—

"'The city of Boston; the chief ornament of New England. The patriotic spirit of her inhabitants placed her on that eminence she now occupies to the honor of the whole country. It is the wish of every citizen of the State that her welfare may continue undiminished, and her prosperity go on increasing.'

"Excellent speeches were made by Mr. Speaker Winthrop, Mr. Attorney-General Austin, Mr. Peabody, President of the Corporation, Mr. Duncan of New-Orleans, Mr. Girard of New-York, Mr. Phillips, of Salem, Messrs. Park and Degrand of Boston, and several other gentlemen who addressed the company on the occasion, but we must confine ourselves to a few of the sentiments offered and drank with great applause.

"The Rev. Dr. Flint being called on, offered—

"'Railroads—the strong clamps which are destined to bind together with ribs of steel the whole of this great country; may they be multiplied and extended till they shall have cemented this Union beyond the possibility of severance.'

"By Mr. Peabody—'The old State of Massachusetts; a noble monument of what may be done by industry and enterprise. If her soil refuses to produce good crops, it yields a plentiful harvest of good men.'

"By Mr. Park—The act of incorporation of the Eastern railroad is a misnomer. It should rather have been called 'an act to repeal an act declaring Massachusetts and Maine to be separate and independent States.'"

***First Annual Report of the President and Engineer-in-Chief of the Central Railroad and Banking Company of Georgia.*** L. O. Reynolds, Chief Engineer.

*Engineer Department, Central Railroad, Savannah, May* 10, 1838.

To Wm. W. Gordon, President:

Sir—It is one year since the charge of the operations of this department was committed to me, and I now have the honor to present you a report of the same.

It is proper that I should first state the progress that had been made, and the condition of the work at the time it was placed under my direction.

In the summer and fall of 1834, an experimental survey was made under the direction of Col. Cruger, at the request and cost of the City of Savannah, to ascertain the practicability, and approximately the cost, of constructing a Rail Road from this City to Macon. This survey demonstrated the practicability, and at a moderate cost, of what we have since denominated the "Northern Route." A full report has been published, with which you and the public generally are well acquainted.

In April 1836, this Company was organized, and preparations made for commencing operations without delay. A Chief Engineer was appointed, and under his orders a more minute and careful examination of the "Northern Route" was commenced at Macon on the 15th of September of that year, by a party under my direction. The Board of Directors, as well as the Stockholders, were by a large majority in favor of this Route, in preference to one further South, provided it could be pursued without too great a sacrifice of distance and expense.

The general features of the Route of this second survey, were similar to the first, with such variations as a knowledge of the country, gathered from the first examination suggested.

Commencing at the Court-House in the City of Macon, the water table of which was assumed to be 386 feet above Tide water, a line of levels and a survey of courses and distances, were carried immediately across the river Ocmulgee, then bending to the right, passed along its margin, alternately cutting off projecting points of the high land, and crossing occasional arms of the river swamp, until the valley of Stone Creek was reached, about 7 miles from Macon—here the line deflects suddenly to the left, and enters that valley, which was examined to the point in the summit ridge, where Col. Cruger's line crossed, at the plantation of Mr. Chappell. It was found that with a maximum slope of 21$\frac{12}{100}$ feet per mile, which was prescribed by the Chief Engineer, a cut of 70 feet would be required to pass this point. A survey was then commenced, and continued along the summit of the ridge dividing the waters of the Ocmulgee, and those of the Oconee, in a northerly direction of 13 miles, with a view of ascertaining with certainty, the lowest depression in that ridge, which would be available for the passage of the road.

This ridge is well defined, and in its general direction is parallel to the Ocmulgee, and at a mean distance of about 9 miles from that River—the average height being about 580 feet above the valley. The ridge survey was terminated in Jones County, on the public road from Macon to Milledgeville, about 1 mile East of the point where the road branches to Clinton.

At this place the head branches of Walnut Creek, which empties itself into the Ocmulgee near Macon, on the one hand, and of Commissioners' Creek which discharges into the Oconee on the other—approach within a few yards of each other, offering to the eye a favourable pass for our Rail Road, as well as a favourable route to descend on either side of the ridge.

An experimental line was commenced at this point, which was found to be 619 feet above tide—and continued down the branches of Walnut Creek towards the Ocmulgee, for a distance of 6 miles: in this distance the descent of the valley had so far exceeded our maximum rate, as to render the prospect of finding a route without exceeding 21 feet per mile, hopeless; this line was therefore abandoned.

The lowest depression found in the ridge, is about 5 miles North of the summit at CHAPPELL's, and 40 feet lower, being 530 feet above tide. At this place the head branches of Stone Creek on the West, and Big Sandy Creek on the East are separated only by a sharp mound of about 1000 feet in width, requiring to be reduced about 37 feet at the highest point; the material being a compact argilaceous sand, which generally prevails throughout the pine barrens. A line was then run down this branch and connected with our first survey at Davis' Mill, on Stone Creek, about 3 miles from the summit, and from the top of the ridge eastwardly down the Branch of Big Sandy to the main Creek—crossing this at Perriman's Mill, and following the valley to the flat lands of the Oconee River about 30 miles. There is no difficulty in getting a favourable line along the valley of Big Sandy Creek on either side; our line however lay on the North side. On reaching the flat lands at the Oconee, we make a sweep to the left, and keep the river flats in a northerly direction about 7 miles to Bond's ferry, near where the line crosses the river at an elevation of 25 feet above the water, (at that time so low as to be barely boatable,) which is 236 feet above tide, and 88 feet lower than the Ocmulga at Macon. There is here a flat rock extending across, and forming the bed of the river, which offers an excellent foundation for a viaduct.

The line now bends again to the left, and follows the low lands of the river to Buffalo Creek, which is crossed near its entrance into the River Swamp, and followed on the northern side about 5 miles to Youngblood's Bridge—here the line recrosses, and pursues the southern bank of the stream about 3 miles, to the valley of Keg Creek, where the ascent is commenced to the summit of the ridge dividing the Oconee and Ogechee waters. This is effected by means of a stream called Limestone Creek, which has its source in a great number of heads near Sandersville.

Several attempts were made to find a route by different branches of the stream without success, but at length a line was found, which, though rather expensive and somewhat devious in its course, is practicable without exceeding an ascent of 21 $\frac{12}{100}$ feet per mile.

A great saving would of course be made by adopting in such parts of the line as we are now speaking of, a grade of 30 feet per mile, and the line could in all other respects be much improved by such a change. This subject will however be taken up in a subsequent part of this report.

Having reached the summit near the town of Sandersville, which is found to be about 500 feet above tide, we find an easy descent towards the Ogechee, by the branches of Williamson's Swamp to the main Creek, and following that to its junction with the Ogechee, we cross that river about 12 miles below the town of Louisville. Many lines were run with a view of finding a favourable crossing place higher up the river; but the table of land occupying the space between the Ogechee and Williamson's Swamp, though tolerably level on its face, approaches the river so abruptly as to forbid a descent at 21 feet per mile, without a long and heavy cut and fill. It therefore became necessary to fall down to near the junction of the streams as above described. A very favourable country for a Railroad is then passed over, through the County of Burke; the line crossing Baker's Branch, Bark Camp Creek, Jones' Creek, and Buck Head Creek, with several small streams. Soon after entering the County of Scriven, Paramour Hill presents itself as an obstacle to our progress. This hill makes up to the Ogechee so abruptly, and is at the same time so deeply channelled by ravines and protruding points of high land, that a passsage for the road between the hill and the river is forbidden, without laying the line for a long distance in the River Swamp. To do this an embankment from 15 to 18 feet high, and a mile long would be required. This would be every year exposed to the freshets of the river, and would require a revetment of logs, there being no stone to be obtained for that purpose in this section of country.

The survey was therefore conducted around the summit of the hill, at a distance of about a mile and a half from the river, not however without encountering a very expensive series of cuttings and fillings to enable us to keep within our maximum grade.

After passing this point, the line was continued through the pine barrens of Scriven County, which present an undulating surface requiring occasionally heavy work to effect a favourable grade. The County of Effingham throughout its whole extent presents an extremely level surface; over these level lands the line was run into the County of Chatham, and terminated about the 1st of January, by connecting with a line about 15 miles from Savannah, which had been run by direction of the Chief Engineer, who had arrived from the North about six weeks previously.

The distance by the route I have just described is 210 miles, but it is susceptible of several improvements and alterations, by which I think it could be reduced to 200 or less. Some of these have been made, and others are now in progress and will be explained in their proper places.

On the arrival of the Chief Engineer in November, several exploring parties were organized and took the field with a view of finding a more direct route than the one above described; and in the mean time a line was run and located for the distance of about 9 miles from the City, in a direction which would be common to any route that might subsequently be adopted. A force of one thousand men was placed on this line, and the grading commenced on the Company's account; this method having been recommended by the Chief Engineer as being preferable to placing the work under contract.

The several parties in the field were employed in running various experimental lines, the most important of which were a Base line from the Ogechee River to Dublin in Laurens County. A Base line from the Ogechee River to Tatnall Court-House. A survey and levels of the New Dublin road. A line from Macon to Turkey Creek on the Oconee. A ridge survey from the head of Big Sandy Creek to Turkey Creek.—Surveys and levels between the Oconee and Ocmulgee, of the valleys of Ocwalkie, Turkey, Stichatchie, Beaver-dam, and Rocky Creeks.—Surveys between the Ohoopee and Ogechee Rivers, of the vallies of Pendleton's, Cedar, Bull, and Black Creeks, a traverse of the south-west side of the valley of the Canouchee; with many other surveys of less magnitude, including traverse lines of most of the small streams in the vicinity of the Dublin and Tatnall bases between the Ogechee and the Canouchee Rivers. These surveys up to the end of April, including that of the North route, amounted in the aggregate, to a distance of upwards of 1000 miles; and were nearly all of them protracted—the plans on a scale of 2000 feet to 1 foot, and the profiles on a similar scale horizontal, and 200 feet to the foot vertical.

Approximate estimates of cost were made from the profiles, and on the 26th January, 1837, the Chief Engineer reported to the Board of Directors, that a route was practicable 30 miles shorter, and $500,000 less expensive than the northern route. On the following day the Board passed a resolution, adopting what has since been denominated the "Southern Route," and ordering the grading to be continued accordingly—the large force employed having by this time pushed the work as far as the line was common to both routes.

The surveys on which the estimates (forming the basis of the report above alluded to) were made, may be stated as follows.

1st. The entire experimental survey of the northern route described in the beginning of this report.

2d. The Base line from the Ogechee River to Dublin—thence to the mouth of Big Sandy Creek, (this last distance not having been surveyed was assumed to be 20 miles, and estimated equal to an average cut of 4 feet.) From the mouth of Big Sandy Creek to Macon, by the survey of that portion of the north route, thus forming a connecting line to Macon, with the exception of the interval between the mouth of Big Sandy Creek and Dublin.

The profiles were graded to a maximum slope of $21\frac{12}{100}$ per mile, and gave the following result:

| | |
|---|---|
| 1st. Northern route, distance 210 miles, | |
| Excavation and Embankment, | 7 500 254 C. Yds. |
| 2d. Southern route, as above described, | |
| Excavation and Embankment, | 9 059 214 C. Yds. |
| Difference of Excavation and Embankment, in favour of the northern route, | 1 549 960 C. Yds. |
| Difference in distance in favour of southern route, | 36 miles. |

It was now assumed, that if the southern route above described, a great part of which consisted of a straight line, presented so favourable a comparison with the northern, by making deviations from that straight line, a route could be found that would still be 30 miles shorter, and the cost be thereby reduced to half a million of dollars less than the northern line.

Surveys were continued to the end of April for the purpose of effecting that object, and which have been detailed above. It appeared subsequently, however, that no favourable line could be found without falling so far down the country, as to make the distance nearly or quite equal to the northern route.

The route which was eventually intended by the Chief Engineer, crosses the Ogechee River about 2 miles below Jencke's Bridge, and passes over Black Creek at Bird's Mill, thence in a straight line to Lott's Creek, which it crosses about 3 miles above its junction with the Canouchee River, and following up this river it crosses it near the mouth of Cedar Creek—takes up the valley of this creek to its head—passes over a summit into a small branch, ahd is then conducted to the

Ohoopee River—passing this river about 4 miles above the mouth of Pendleton Creek, it falls down into the fork of this creek and the Ohoopee, and continues up the valley of the former nearly to its head, then crossing over to the Oconee and passing this river a short distance above Turkey Creek, which is followed to the mouth of Rocky Creek—thence the route passes over to the head water of the Little Ocmulgee, and falls into the valley of Shell-stone Creek, by which it reaches the Ocmulgee in the vicinity of Taversville, and continues up the river to Macon.

As a considerable portion of this last described route has not been instrumentally examined, the precise distance connot be stated; but an inspection of the State Map will shew that it is nearly or quite as long as the northern line. It was the result of a reconnoisssance made by the Chief Engineer in the first part of the month of May, together with instrumental surveys before made, and which have been detailed above. Soon after returning from this tour of reconnoissance, he resigned the appointment Chief Engineer; and on the 10th of May, this department was placed under my direction.

The Board of Directors had become fully satisfied that the plan of carrying on the work on the Company's account was attended with great waste and sacrifice, involving a necessity of the employment of a host of superintendants, clerks, overseers, cooks, bakers, butchers, ostlers, &c., and were very desirous of placing it under contract. Accordingly, in the early part of March, the grading then remaining to be done from a point about 12½ miles from the depot at Savannah to the Ogechee River—a distance of 6 miles, was put under contract. Several short pieces between this point and the City remained however to be finished by the Company, all of which was soon completed, excepting the heavy embankment on the first of the road, which will be particularly mentioned hereafter.

On the 3d of June I received a communication from the President of the Company, in which he says: "Doubts have arisen, whether the true policy of this Company is not to open again the question of route, as we have not yet crossed the Ogechee, we may better now than hereafter change our route; and the questions on which you are now asked to advise the Board, are—

1st. At what point of the road now grading would the line of the northern route diverge if a change was determined on; and what amount in distance and value of work already done would be sacrificed?

2d. What are the advantages of the northern over the southern route; and what would be the increased distance of the former over the latter?

3d. What points on the northern route should be examined before a just and proper contrast of the two routes could be made? How long would it take to make such examinations?

4th. Could the proper data for a determination be obtained in time to put under contract 30 to 40 miles on either route before the 1st of November next?

5th Whether an alteration of the present maximum rate of grade from $21\frac{12}{100}$ to 30 feet per mile, would be attended with more advantages on the northern than on the southern route; and whether if such alteration were admitted, a location at once on the northern route might be ventured on, with the assurance that the difficulties on that route would be overcome by such alteration?

6th. Where the first obstacles on the northern route would be found?

I ask an early answer to these queries, and that your answer convey to the Board all the information on the subject in your possession."

In my reply to the above communication, I made the following statements:

"The point of divergence from the present graded road, should a change of route be determined on, would be within a short distance of the western side of the Little Ogechee.

The sacrifice of work already done would be $10,500 exclusive of engineering, and in distance about one mile and a half.

Among the many advantages of the northern over the southern route, are the following: An earlier developement of the benefit of the project both to the Company and the public. On the northern route, the work and expense of construction will be light for nearly the whole distance hence to Sandersville.

The Board is aware that the trade of the Counties of Washington, Jefferson, and Burke, was formerly enjoyed by Savannah, and until the introduction of Steam Boats on the Savannah River, which placed Augusta nearer on a level with this City, as a mart for the purchase and sale of produce and merchandize. Then, the trade of these Counties took that direction merely, on account of the shorter transportation.

The consequence has been, the decline of Savannah and the advancement of Augusta. Can we doubt that the establishment of a permanent, certain, and cheap line of transportation through these Counties, would reclaim to our City her lost trade?

The advantage of such a result, would not be merely the transportation of the Cotton crop. The intercourse of the inhabitants would be with this City instead of Augusta and Charleston. There supplies would be drawn from here, and the causes of the decline of Savannah being thus in a considerable degree removed, we might look with confidence to see her resume her former state of prosperity in a short period.

We approach within 10 or 12 miles of Louisville—within 2 miles of Sandersville—within 18 miles of Milledgeville—within 3 miles of Irwinton; and if the route via Commissioners and Walnut Creeks be found practicable, (of which I have very little doubt, provided grades of 30 feet per mile be admitted,) within 4 or 5 miles of Clinton in Jones County. Communications with all these places would doubtless be formed, and each of them being the nucleus of a more or less active, and some of them of a large trade: their passengers and light goods would yield a large revenue to the road.

A branch from this road to Sparta in Hancock County, (probably about 25 miles,) would take in a large circle of that rich and populous country, and could be made at a moderate cost.

The near approach of our road to Augusta (48 miles), would doubtless attract many passengers. Improved lines of stages would immediately connect with us, as the roads in that section are very good; and that great desideratum—a daily communication between this City and Augusta would be accomplished.

The greater facility with which slave labor can be obtained on the northern route than on the southern, I consider a great advantage. On the southern route, no negroes can be obtained until we reach the vicinity of Taversville in Twiggs County.

It is admitted that in the section of the country last named, a large amount of Cotton is made, and there are many wealthy inhabitants; but we should have the navigation of the Ocmulgee to contend with, which in ordinary stages of the river would take a large part of the crop.

By the adoption of the northern route, we should obviously be in a better position to participate in the advantages of the various schemes of internal improvement now in agitation, than if we were to adhere to the southern.

The time will not permit me to collect the data for furnishing you with a statement of the amount of goods transported from the sea-board to the different counties through which the road and its probable branches would pass; or their Cotton crops; I have no doubt however, that the Board is well informed on the subject.

There are many other advantages that will be overlooked in this hasty communication: and probably many that would strike the members of the Board, that might escape me.

The increased distance of the northern over the southern route, cannot with any certainty be ascertained, as no line as has yet been definitely fixed on for the whole extent of the southern route.

(To be continued.)

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(Continued from page 112.)

## *Semi-Annual Report of the Water Commissioners, from the* 1st *of July, to* 30*th December*, 1837, *inclusive.*

The plan of carrying the aqueduct across by means of iron pipes resting on a stone bridge has the following general character.

A semi-circular arch of 80 feet span, resting on abutment piers, which are raised 10 feet above flood tide, making the total height, from the level of flood tide to the under side of the arch, 50 feet, is placed next the southern shore of the river, to form a channel way for the same. At present the channel is about 150 feet from this shore, but the situation is favorable, and the tide current will very shortly cut a new channel, when it is restricted to a passage through this arch; and form as good a channel as the present, for any purposes, should it ever be wanted. From the north abutment of this arch to the north shore of the river, it is proposed to make an embankment of stone to support the foundation wall of the aqueduct. From the south abutment pier of the main arch, there is an arcade of three arches, one of thirty-five, one of thirty, and one of twenty-five feet span. From the south abutment pier of this arcade a foundation wall is carried up the ascent until it reaches the grade level on this side of the river. On the north side of the river, an excavation is made through the table land, and up the slope of the hill to the grade level, in which the foundation and side walls are to be laid, to receive the pipes. The foundation wall above described as extending each way from the abutment of the arches, is designed to be formed of dry masonry, except two feet on each side, constituting the face, and two feet across the top, to form the bed for the iron pipes, which are to be laid in cement. A parapet or retaining wall is to be raised on each side to support the earth covering, which is to be four feet deep above the pipes.

Commencing on the north side at the influent pipe chamber, the preparation for the pipes descends nearly parallel to the slope of the hill, making a small angle near its base, and thence to the level adopted as the lowest, which fixes the top of foundation wall for pipes, at four feet above flood tide. This level is continued to the angle it is necessary to make to rise over the high arch, from whence an inclined plane is carried to the effluent pipe chamber on the south side of the valley.

A foundation wall is designed to form the beds of the pipes. This might, in a great degree, be dispensed with, as in ordinary cases; but in order to guard against any injury that one pipe might receive from a rupture in another, it is deemed prudent to give a solid foundation, that would resist a current of water, should an accident occur.

An influent and an effluent pipe chamber will be required; one at the termination of the aqueduct, on the north side of the valley, and the other on the south side. Into these chambers the pipes will respectively be inserted, in well wrought masonry. It is proposed to arrange the pipes in such a manner as to admit of a gate for each pipe, so placed that one may operate independently of the others; in order that any one pipe may have the water shut off, and undergo any repairs that may be required, without disturbing the regular operation of the others. The walls of the pipe chambers are to be carried up and receive a roof, to protect the chamber and gates from improper approach; and serve, at the same time, a useful purpose as a receptacle of tools, and such materials for repairs, as it may be prudent to have in store The gates are to be of cast iron, working in well fitted frames of the same material.

At some convenient place, in the lowest level of the pipes, a stop cock, to operate as a waste cock, will be required. The object of this is, to clear out any sediment that may accumulate in the bottom. It is probable very little will ever be deposited, that cannot be forced through by a current that might be made in the pipe; but the waste cocks are deemed the most certain, effectual and convenient means of accomplishing this object. It is proposed to enclose the waste cocks in the same manner as the pipe chambers.

The width of the bridge must depend on the width required for the pipes: and this again, will depend on the diameter of the pipes. A single pipe, sufficiently large to carry the whole quantity of water, would be accommodated on the most narrow bridge. There are, however, objections to this: a single pipe would place the successful action of the aqueduct on its good condition; consequently, interruption would be involved in any necessary repairs; which it is important to avoid, by every reasonable means in our power; and very large pipes would be more liable to imperfections than smaller ones. Water pipes of cast iron have not, that I am aware of, been larger than three feet diameter. The principal iron mains, in the water works of London, are of this size; and the same are used in a part of the water works in the City of Glasgow, in Scotland. I can see no reason why this particular limit has been adopted, unless experience has decided it to be most economical. There certainly can be nothing impracticable in going to four feet, so far as the making the casting is concerned, for experience in casting cylinders for steam engines has demonstrated this; and were there any particular necessity for this dimension, I should have no fear that it might be successfully accomplished. But in view of all the circumstances of the case under consideration. I have arrived at the conclusion, that three feet pipe will be most appropriate.

In order to economize the expense of crossing this valley by iron pipes, I have allowed two feet fall, in addition to the declivity that would be given by the regular inclination of the aqueduct. Without stopping here to explain the influence of this measure, I will merely observe, that we shall still have, at the distributing reservoir, as great an elevation as it will probably be thought expedient to maintain at that and the intermediate ground. With this declivity, four pipes each three feet diameter, will be sufficient to discharge the same quantity as the aqueduct of masonry, on the established inclination. The comparison is as follows:

One pipe will discharge 2,000,163 cubic feet, or 12,460,996 imperial gallons, in twenty-four hours—and

| | | | *Imperial Gallons.* |
|---|---|---|---|
| Four pipes | 8,000,652 cubic feet | . | =49,843,984 |
| Aqueduct of masonry | 7,953,120 " " | . | =49,547,937 |
| Excess of pipes | 47,532 " " | . | = 296,047 |

I have made a computation for pipes 30 inches in diameter, and find the ratio of discharge of 30 to 36 inch pipe is as 1 to 1·55; and the ratio of cost is as 1 to 1·26. It therefore appears, that, (more than 6,) say 6 pipes, of 30 inches, would be required to discharge the same quantity as 4 pipes of 36 inches. The comparative account of expense for pipes to discharge the same quantity, allowing the 36 inch only a 50 per cent. greater discharge, will be as follows:

| | |
|---|---|
| 6 pipes, 30 inches diameter, at 1 . . . . . . | = 6·00 |
| 4 " 36 " " at say 1·25 . . . . | = 5·00 |
| Difference | 1·00, or |

the 30 inch pipe will cost 20 per cent. more than the 36 inch, to discharge the same quantity of water.

The bridge to support the pipes will require to be at least 6½, if not 7 feet wider for 30 inch than for 36 inch pipe, which will increase the cost $30,000. This, added to the difference in the pipes, will make the total excess of cost for 30 inch pipe over that for 36 inch, $54,000.

If it be inquired, why not institute a comparison for pipes of larger diameter? the answer will be found, in part, from my observations in the preceding pages; on experience at the London and Glasgow Water Works, where 3 feet seems to be the maximum size in use; and the propriety of having two pipes, as a measure of prudence, that one may supply, in the event of any repairs being required on the other. But we have four 3 feet pipes. This is true in relation to the ultimate perfection of the plan; but only two are designed to be put down in the first instance, as they will probably be sufficient for the next fifty years; and the additional ones may be laid down whenever the wants of the city shall demand them.

#### ESTIMATE FOR AN INFLUENT PIPE CHAMBER.

| | | |
|---|---|---|
| 110 cubic yards concrete and rubble masonry in foundation, at $6 . . . . . . . . . . . | | $660 00 |
| 70 cubic yards cut stone masonry in flagging, jambs, lintels to gates, and pipe apertures, at $33 . . . . . | | 2,310 00 |
| 180 cubic yards side, spandrel, and retaining walls, at $12 | | 2,160 00 |
| 15 " " arch stone, at $20 . . . . . . | | 300 00 |
| 95 " " masonry in house walls, at $7 . . . . | | 665 00 |
| Roofing, doors, and windows of house, estimated . . | | 300 00 |
| | | $6,395 00 |
| 4,200 lbs. iron castings, for gate frames and gates fitted up complete at 8 cents .. .. . | $336 00 | |
| Carried over, | $336 00 | $ 6,395 00 |

| | | |
|---|---|---|
| Brought over, | 336 00 | $6,395 00 |
| 200lbs. wrought iron, in screw rods, screw bolts, and wrench, complete. at 25 cents | 50 00 | |
| 100lbs. wrought iron clamps, for securing coping and jambs, at 12 cents | 12 00 | |
| 1,200lbs. lead, for fastening clamps and making joint between mouth of pipe and masonry, at 9 cents | 108 00 | |
| 14,400lbs. iron castings, in wall pipes, at 5 cents | 720 00 | |
| Workmanship in putting down pipes and hanging gates | 200 00 | |
| | | $1,426 00 |
| | | $7,821 00 |

The plan of influent and effluent pipe chamber will be similar; consequently, the estimate will be the same for each.

By a letter from F. Graff, Esq., of Philadelphia, I have been furnished with a statement of the cost of iron pipes, at different times, in that city; from which it appears, the ordinary size pipe has cost from $50 to $65 per ton. And Mr Graff gives it as his opinion, that pipes three feet in diameter, may be furnished at from $70 to $75 per ton. But, in order to be safe, I have put this item at 4 cents per pound, in the estimate.

It is proposed to make the metal of the pipes one inch in thickness; except at the hubb, which is to be 1·75 inches. As less than one-third of an inch is competent to bear, permanently, the pressure of water on the pipes, an inch may be considered abundantly safe; and this thickness will ensure a perfect casting.

The pipes are usually cast 9 feet long. The lap, for pipes of this size, may be 7 inches; leaving the length each piece of pipe will make, when laid down, 8·42 feet. A piece of pipe will contain 13,479·21 cubic inches × ·27 = 3,639lbs., equal 432lbs per foot run of pipe laid.

ESTIMATE OF EXPENSE FOR ONE FOOT OF PIPE LAID DOWN.

| | | |
|---|---|---|
| 432lbs. castings, at 4 cents | | $17 28 |
| 200lbs. lead for one joint, at 9 cents | $18 00 | |
| Yarn, tallow, &c., estimated at | 1 00 | |
| Labor laying down and making joint | 5 00 | |
| Transportation | 3 00 | |
| | $27 00 = | 3 20 |
| | | $20 48 |

GENERAL ESTIMATE FOR PLAN BY PIPES.

| | | |
|---|---|---|
| 1,800 cubic yards rock excavation, at $1 50 | $2,700 00 | |
| 10,500 cubic yards earth excavation, at 14 cents | 1,482 00 | |
| | | $ 4,182 00 |
| 25,000 cubic yards stone embankment at $2 00 | | 50,000 00 |
| 800 " " slope wall, at $2 50 | | 2,000 00 |
| 950 " " main foundation wall, laid in cement, rough hammered, at $7 00 | | 6,650 00 |
| Carried over, | | $62,832 00 |

| | | | |
|---|---|---|---|
| | Brought over, | | $62,832 00 |
| | 6,500 cubic yards main foundation wall, laid dry, in interior, at $2 50 . . . . . . . . . | | 16,250 00 |
| | 720 cubic yards side walls, north side of river, at $6 00 | | 4,320 00 |
| | 1,400 cubic yards side and parapet walls, from north side of river to angle, at $7 00 . . . . . . . | | 9,800 00 |
| 980 | 700 cubic yards parapet wall, from angle in river to pilaster of main arch, at $8 00 . . | | 5,600 00 |
| | 280 cubic yards parapet wall, between south pilaster and south shore, at $8 00 . . . | | 2,240 00 |
| 3,000 | 2,200 cubic yards wall for foundation of pipe, exclusive of that over the arches, at $6 00 . . | | 13,200 00 |
| | 800 cubic yards wall for foundation of pipe, over arch and between pilasters, at $6 00 . . | | 4,800 00 |
| | | | $119,042 00 |
| | Main arch, 521 cubic yards, at $30 00 . | $15,630 00 | |
| | Three small arches, 391 cubic yards, at $25 | 9,775 00 | |
| | Abutment and pier of main arch . =1,250 | | |
| | Abutments for small arches . . =1,088 | | |
| | 3,338 | | |
| | cubic yards, at $12 . . . | 40,056 00 | |
| | Exterior spandrels to main arch, = 800 cubic yards, at $10 . . . . . . | 8,000 00 | |
| | Spandrel walls, solid for small arches, 832 cubic yards, at $6 . . . . . . . | 4,992 00 | |
| | Hance wall for main arch, 500 cubic yards, at $7 | 2,500 00 | |
| | Pilasters, 230 cubic yards at $12 . . | 2,760 00 | |
| | Parapets, exclusive of coping and water table, 680 cubic yards, at $12 . . . | 8.160 00 | |
| | Water table and coping, 250 cubic yards, at $30 | 7,500 00 | |
| | Coffer dam, including excavation and pumping; based on a detailed estimate for *high* bridge, being larger and more expensive by about fifty per cent. . . . . . | 22,000 00 | |
| | Centering for arches . . . . . . | 3 500 00 | |
| | Earth covering, 5,500 cubic yards, at 30 cents | 1,650 00 | |
| | Earth covering, 9,000 cubic yards, at 15 cents | 1,350 00 | |
| | | | 128,823 00 |
| | Total for bridge . | | 247,915 00 |
| | Two pipe chambers, as per detailed estimate, at $7,821 | | 15,642 00 |
| | Waste cocks, and house over them, estimated, . . | | 2,500 00 |
| | 1,480 feet of pipe, as per detailed estimate, at $20 48 = 30,310 40×4 pipes . . ; . . . | | 121,241 00 |
| | | | 387,298 00 |
| | As this work is, in some parts, liable to greater contingent expenses than usual; and also extra superintendence, I have considered it proper to add ten per cent. on the whole: which is independent of the ten per cent. to be allowed in the general estimate, for contingencies and superintendence . . . . . . . . . . | | 38,729 00 |
| | **Making the total cost by pipes** . | | **$426 027 00** |

The estimates for the two methods are now ready for comparison.

| | |
|---|---|
| High bridge, maintaining the established inclination over the valley . . . . . . . . . . | $935,745 00 |
| Pipes supported on a low bridge . . . . . . | 426,027 00 |
| Excess of high bridge = . . . . | $509,718 00 |

No allowance has been made for the loss of two feet elevation by the pipes. It is not believed, however, that this would make any material difference, excepting for about four miles north of Harlaem River, where it might be expedient to lower the grade a few feet; which would not produce any important difference. But in order that the estimate should not be presented in a manner to do injustice to the high bridge, nothing has been added for contingencies; which, I believe, from a careful review of the estimates, is quite as much rrquired for this as for the plan by pipes.

It appears the plan by pipes has largely the superiority in point of economy. In my opinion, it will be fully as efficient. The pipes will decay, by the action of time, more rapidly than stone masonry; especially, if the masonry can be kept from injury by frost. But as only two, or half the pipes, are required to be put down at present, it may be assumed, that if the $66,000, saved by this, is invested at five per cent. it will produce a sum that will forever maintain the pipes, to the full extent that may be wanted. The high bridge will be more exposed to casualties that may, at some future period, seriously interfere with the successful operation of the aqueduct. It is, however, greatly superior, in point of architectural magnificence, and maintains two feet greater elevation. These are the only points of superiority I have been able to discover, and can therefore have no hesitation in recommending the plan by pipes as decidedly the most appropriate. Respectfully submitted.

John B. Jarvis, *Chief Engineer, N. Y. W. W.*

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## *Mew-York and Albany Railroad.*

We published in No. 3 the proceedings of a spirited meeting of the inhabitants of Westchester and Dutchess counties, in relation to the New-York and Albany Railroad; and we now publish a communication from the Commissioner, Joseph E. Bloomfield, Esq. to the President and Directors of the Company, giving an estimate of the amount of business which will naturally pass over this road—with the single remark that *any* estimate made upon present data, will be more than realized when the road shall have been completed in 1842:—

**To the President and Directors of the New-York and Albany Railroad Company.**

Gentlemen:—An able pamphlet, with "Facts and Suggestions" relating to the New-York and Albany Railroad, laid before the public on a former occasion, leaves but little to add to show the importance of this main stem to all our Northern lines of Railroads.

The Railroads now in the course of construction, from Boston to Albany, thence to Lake Champlain, Ontario, Erie, and to the "Far West," the trade and travel on which will seek the New-York and Albany Railroad, exceed 2000 miles in length. Travellers on these roads, to approach the city of New-York at all seasons of the year, must use the New-York and Albany Railroad.

The New-York and Erie Railroad Company, to enter the city of New-York, in conformity to their charter, will naturally seek a junction with the New-York and Albany Railroad. The Southern tier of counties, will call for this, as a *sine qua non* to advance the interests of their commercial emporium and their own prosperity.

It has been found that this Southern trade can be brought to the North river, via Newburg, Kingston or Catskill, upon a more favourable, as well as shorter route, (grades considered) than by cutting through the Shawangunck mountains.

This fact is verified by the surveys made by the engineers employed by the Ulster, Catskill and Canajoharie Railroad Companies and others.

Should the State assume the construction of the Erie Railroad, (which she has reserved the right to do in the charter) the money for its construction will be disbursed in those counties where it can do the most good and subserve the interest of the greatest number.

The importance of the New-York and Albany Railroad, to the "secluded districts" of the Eastern river counties, is brought to view by the Geological report of Mr. W. W. Mather to the last Legislature (Assembly Doc. No. 200). The information in this document is various and valuable to the public, and may be relied on. The entire report on the first district extends over forty pages replete with interesting matter.

The annexed extracts, in a condensed form taken from a Poughkeepsie paper, show "inexhaustible beds of iron ore," with quarries of marble, granite, and lime-stone, "without limit to any finite period of time." The value of these materials for building, and their cheap transportation into the heart of the city of New-York by the railroad, must be apparent to every person.

In addition to the mineral and building materials, the rich agricultural products of Westchester, Putnam, Dutchess and Columbia counties, claim attention, furnishing important items of revenue to this road.

The New-York and Albany Railroad will afford an avenue for the transportation of the various articles daily required for the consumption of families, and this too at half the rates of transportation now paid to transfer them to the Hudson river from the counties of Westchester, Putnam and Dutchess, to be monopolized at our wharves by those who forestal our markets in the necessaries of life. The yearly saving to the city in transportation and prices, would build the New-York and Albany Railroad. To illustrate this view, it is fair to presume the construction of this railroad will reduce the price of provisions and the expense of housekeeping full 25 per cent.

There are in Brooklyn and New-York (six persons to each family,) fifty thousand families, besides persons employed in packets, steamboats, &c., who spend on an average at least $250 per annum. This multiplied by 50,000 will give the sum of $12,500,050, one-quarter of which $3,125,000, it is safe to calculate, would be yearly saved, by the construction of the New-York and Albany Railroad, in provisions, buildings, &c.

With the certain and rapid increase of the city of New-York, what will not our prices rise to for the necessaries of life, unless we open an avenue to the interior? It is said, and no doubt correctly, that the city of New-York now derives one-half of her supplies of fruit and delicate vegetables from New Jersey, principally along the line of the Amboy and Camden Railroad, and but for this railroad our markets could not be adequately supplied.

An estimate of the income which the New-York and Albany Railroad will yield to the stockholders cannot be given with accuracy. We subjoin what is believed to be substantially correct, it is derived from the best sources of information.

The first view that will be taken of "the probable business of the New-York and Albany Railroad for one year," is a statement made July 1836, by a Committee of the town of Pawlings in Dutchess county, of which Jonathan Aikins was chairman. They say, "with a view to more accuracy, we begin with our own town of Pawlings."

IMPORT OF PAWLINGS.

| | | |
|---|---|---|
| 150 | Tons of Plaster at $5, per ton, | $750 |
| 60 | " of Merchandize, except salt, | 300 |
| 60 | " of Salt about 5½ bushels to each family, but when pork is barrelled in the country, it is a much larger quantity, | 300 |
| 30 | " Lumber, staves, ploughs, mill gear, &c., | 150 |

EXPORTS.

| | | |
|---|---|---|
| 90 | Tons of fresh pork, when barrelled, much more, | 450 |
| 120 | " Grain, flax seed and other products, | 600 |
| 40 | " Dairy, products, small stock, poultry, &c., | 200 |
| | | $2,750 |
| 1200 | Passengers, at the present prices by the Steamboats, being 600 each way, | 2,400 |
| | | $5,150 |

NOTE—It is too expensive to transport Hay to the Hudson river.

| | |
|---|---|
| We next take two towns in Putnam, viz: Patterson and South East, each equal to Pawlings, | 10,300 |
| We then proceed to six towns in Westchester, through which the New-York and Albany Railroad will pass—say, | 16,000 |
| The town of East Chester, with Mr. Kane's marble quarry, | 15,000 |
| We now proceed to the town of Dover. We are informed by Mr. E. Stevens the owner of one stone saw-mill, that the past year, 1835, he sold $10,000 worth of marble, all tomb-stones, that he contracts with his teamster who transports his marble to the Hudson river, after discharging a load of marble (at Pokeepsie) to return a load of sand for cutting other stone; Mr. Stevens, sells for 50 cents per foot, and 50 superficial feet make a ton (say 2 inches thick.) There are 13 mills in the vicinity, one mill therefore gives 333 tons, but to be safe say 250 x by 13, the No. of mills gives 3250 tons, of which deduct half sold at home, this leaves 1625 at $5, per ton, to the Hudson, equals | 8,100 |
| Call sand only 13,000 tons, | 6,500 |
| 1400 tons for furnace, | 7,000 |
| 550 " other articles same as Pawlings, | 2,750 |
| Add for passengers, | 2,500 |
| | $26,850 |

| | | |
|---|---|---|
| The town of Amenia now produces (1836) from two furnaces, 1400 tons iron, . . . . . . | $7000 | |
| 1000 tons other articles, . . . . . . . | 5,000 | |
| Add for passengers, . . . . . . . | 3,500 | |
| | ——— | 15,500 |
| The towns of Sharon and Salisbury, in Connecticut, we estimate at . . . . . . . . . . . . | | 48,000 |

Careful estimates have been made by the inhabitants of Berkshire county, Massachussets, in reference to the amount of tonnage transported by that county. They put it at about 40,000 tons, annually transported to the Hudson river, the principal part of which goes to New-York. If we put the cost of transportation at the rate of $5 per ton, it will amount to $200,000. That we may certainly be within the truth, we will take, instead of 200,000, only 150,000 for Berkshire county.

It will be observed, that our estimates are at $5 per ton, which only carries to the Hudson river.—We believe the additional cost of freight on the river is frequently charged at 25 cts per cwt.; but we will say $1 per ton, which, for half the amount transported from Berkshire alone, is $20,000.

| | |
|---|---|
| We will now recapitulate our estimate, beginning with the town of East Chester, . . . . . . . . . . | $15,000 |
| Six other towns in West Chester, . . . . . . | 16,000 |
| Two towns in Putnam county, . . . . . . . | 10,300 |
| Pawlings, . . . . . . . . . . . . . | 5,150 |
| Dover, . . . . . . . . . . . . . . | 26,800 |
| Amenia, . . . . . . . . . . . . . | 15,500 |
| Sharon and Salisbury, . . . . . . . . . . | 48,000 |
| Reduced estimate of Berkshire, exclusive of passengers, . | 150,000 |
| Add freight of same on river, . . . . . . . | 20,000 |
| | $306,750 |

This sum is now paid (1836) by the towns alone through which the road will pass, including Berkshire; and is sufficient to pay 24 per cent. gross on the estimated cost of the road [by J. D. Allen, Esq. civil engineer,] from Harlaem river to West Stockbridge. It should be taken into consideration that the towns not enumerated, and adjacent to the railroad, may be safely calculated at one-third the estimate which precedes, $103,250, say, for round numbers, $400,000.

In addition to this view and estimate taken by a respectable committee of the town of Pawlings, in the completion of the road only to Sharon, on the Connecticut line, it is now ascertained by the surveys of Mr. R. P. Morgan, completed to Albany, that the line can be extended through Columbia and Rensselaer counties with no grade to exceed 30 feet in the mile with a distance of 150 miles from the City Hall, New York, to Albany.

The Albany and West Stockbridge Railroad Company must intersect their road with the New-York and Albany Railroad, near the same point on the Hudson and Berkshire Road to reach Stockbridge. This will naturally merge their road into the New-York and Albany Railroad, and will make it the main trunk and thoroughfare to Boston, to the Canadas, and to the West.

The number of passengers by these routes, who will take the Railroad to New York, cannot be stated with any certainty, but from the West we have the fixed data of the Mowhawk and Schenectady Railroad Company, which by the printed reports of the Company, have exceeded 150,000 per annum, for the last three years.

It is safe to estimate, that one-third of this number, say 50,000, would take the New York and Albany Railroad, for the following reasons, to wit:—

1st. To vary the route.

2d. To save from four to six hours in time, and to keep up with the mail which would be carried on this route.

3d. From necessity in the winter, four months of the year.

The average fare for passengers, winter and summer, should not exceed $3—but say $2 1-2—is $125,000.

A large portion of the passengers from Boston, Massachusetts, Vermont and New Hampshire, who seek Troy, Albany, and other points on the North river and Sound, will naturally take the New York and Albany Railroad, so soon as the "Great Western Railroad" of Massachusetts is completed.

This important link in our internal improvements, will be completed within 2 1-2 years, and form a continuous line (of about 270 miles) from New York to Boston, at all seasons of the year. It is safe to estimate the sum of $75,000. as an additional item in the profits of this road to be derived from passengers in this direction, when it is understood that the numerous steamboats that ply daily on the North River, average from the different landings 750 passengers each way for six to seven months in the year.

The celerity with which the mail can be carried to Albany, (6 to 8 hours) also to intersect the branch to Boston in 12 hours, should command from the general government at least $50,000.

Freight.—It is difficult to estimate the amount of merchandize that now finds its way to Philadelphia, and from thence to Ohio and the far west. This trade, on the construction of the New York and Albany Railroad, would seek this route to Albany and Troy, and thence by continuous lines of railroad, in the course of construction, to lakes Ontario and Erie. These lines will be completed within three years—on this point there is not now a doubt. The blockade, by ice, which the city of New-York suffers, on the closing of the canals, for four and a half months, will be removed; the price of flour and other provisions, will be regulated; beef and pork, which are often injured by being killed too early to reach the city on the close of navigation, will form a large item of the profits of this railroad, from their bulk and weight. A month in the spring and fall, of the best milling seasons in Rochester, Oswego, and other points, is lost for all regular and certain supplies of flour.

Half of the amount of grain raised and ground in the State of New-York, is sold and distributed to the New England States.

Those parts of Massachusetts, Connecticut, Columbia, Dutchess, Putnam and Westchester, on the line, will receive their supplies by the New-York and Albany Railroad.

Ship timber of large size, to wit: oak, chesnut, and locust, of the best quality, abounds in the route. It is now valueless, except for fuel at $2 per cord. The frames of vessels can be got on the line of the road, transported to, and put on the Harlaem river, to which point the ship building of the city is destined to pass. Its capacious indentations and security from all winds and currents, indicates the termination of the New-York and Albany Railroad as a position at which to concentrate this business.

Charcoal is now furnished to the many furnaces on the line at an average of 7 cents per bushel. It is ascertained that in clearing off the forest, it will reproduce an equal quantity of coaling timber in twenty years. Should this source of supply fail, from the increased demand in working the iron ore beds, the return cars of the railroad can take anthracite and bituminous coal to supply the deficiency, or, as is most probable, the ore would seek the coal on the banks of the Harlaem river. —The abundance of fuel on the whole line of the road is a very important consideration in the expense of Motive power for transportation.

The counties of Dutchess and Putnam now furnish the New-York market, besides calves, sheep and lambs in great numbers, about 300 head of fatted cattle per week. These cattle are purchased at the west in the autumn, and fatted on their rich pastures the following spring. It has been ascertained that these cattle lose 8 per cent. by driving or by steamboat, independent of about $3 per head expenses to reach the New-York market. This per centage on their average value of $60 each, is a loss to the farmer and consumer of $79,200 per annum. The half of this sum, say $40,000, would be a liberal recompense to the Railroad for the transportation of these cattle, as daily wanted at the Bull's Head.

Calves and Lambs take about 24 hours to collect at the first depot,
24 hours to send to New York,
24 hours before they are killed,

[making 72 hours they are kept with very little food and water, and are killed in a state of fever.

The calves now cost about 75 cents transportation to the city—weight about 125 lbs. 18 pence for calves; and 6 pence for lambs, will pay the Railroad.

Hay in any quantity can be furnished in Dutchess at $7 to $8 per ton, and pressed can be transported to the city $2¼ per ton.

Butter costs the producer 1 cent per pound, to carry to the city, and a like sum is paid to huckstering agents for commissions on sales, equal to $40 per ton.

Say that the value of land is increased only $10 per acre for five miles on each side of the road for 100 miles of the 150—this equals 640,000 acres, or $6,400 000.

This is but an approximation to the value that will be given to the timber, the grass and grain lands.

The marble quarries and inexhaustible iron ore beds, with the trade and transportation of lime, will be immense.

A review of the items of income here thrown together, show the following results:—

| | |
|---|---|
| Passengers . . . . . . . . . . . | $225,000 |
| The transportation now paid on the line of the road, to the Hudson river, is $400,000—say the half of this to deliver them in the centre of the city . . . . . . . . . | 200,000 |
| Transportation of the great Northern and Eastern mails, for Albany and Boston . . . . . . . . | 50,000 |
| Transportation of Beef, Calves, and Lambs . . . . | 400,000 |
| The increased trade, in transportation of Marble, Granite, Lime, and Iron . . . . . . . . . . . | 50,000 |
| | $925,000 |

| | |
|---|---|
| Brought forward | $925,000 |
| Ditto, in agricultural products from the West, and on the line of the road . . . . . . . . . . | 200,000 |
| Ditto from the Dairy, . . . . . . . . . | 25,000 |
| The merchandise, now shipped in the spring by the Pennsylvania Canals and Railroads, it is difficult to estimate. New York, to sustain herself in her natural position, must have a continuous line of Railroads to the upper lakes,—on the completion of the New-York and Albany Railroad,—it is not extravagant to estimate this item, with the increased returns in flour, pork, tobacco, &c. from Ohio and the West, at . | 200,000 |
| Estimated income for one year . . . . . . . | $1,350,000 |

The foregoing statements and estimates have been made by the Commissioner of the Road, at the request and with the sanction of the Executive Committee of the Company.

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## *Long Island Railroad.*

For the Railroad Journal and Mechanics' Magazine.

*Boston, August* 10, 1838.

The western part of Long Island resting immediately on the city of New-York, and connected with it by a ferry of only half a mile in width, is sufficiently known to the inhabitants of that city, as rich in agricultural advantages, not to mention the inducements which it offers to tempt the sober and regular citizen occasionally from his every day beat—but the Eastern section of the Island is all but *terra incognita* to him ; a great portion of it is in fact as much a wilderness, and as far as man is concerned, as much a waste, as any portion of the Western country ; it is, therefore, the privileged haunt of a few sportsmen of the Wilson school, who, in proportion to its exemption from all modern and easy modes of intercourse, such as steamboats, railroads, and the like, (which to the chagrin of the collector and amateur, have lately thrown the most impenetrable fastnesses open to the common admiration of plebeian and patrician) value and eagerly appropriate its peculiar forests pleasures, and hunt the deer, and the wild fowl, uncontrolled and undisturbed by any traces of cultivation.

It is not meant to be said by this, that the Eastern portion of the Island is unappropriated, nor that it is entirely uncultivated ; for on either shore, and especially on the northern, there are continuous patches of cultivation, or clearances, with an industrious, though meagre population. But by far the larger portion of the entire Eastern end of the island is at this moment in a state of nature : the coarse oak scrub, which grows short, but thick and shaggy there., and the patches of pine, which amongst this forest of oak bushes, dot the entire southern plain, appropriate millions of acres ; the deer is common enough there ; the pheasant, until lately, was known on this island ; all descriptions of wild duck, and wild goose, in their seasons, visit these shores comparatively undisturbed ; the partridge, and quail, and woodcock, and plover, are found in plenty ; and, in short, all other denizens of the free forest peculiar to this latitude.

We are now to look at the causes which have left a section of country, bordering so near the City of New-York, so long uncultivated, and we are to consider whether these causes are attributable to the barrenness of the natural soil, or to the want of the means of communication with the City. Want of enterprise in the inhabitants will form no part of this estimate, for it is sufficiently obvious that within 100 miles of the City of New-York such a want must be unknown, did sufficient and comparatively safe opportunities exist to draw it into action.

The northern side of Long Island, or the side which borders on the Sound, consists of an irregular range of miniature hills, for they never exceed 400 feet, and average probably only 200 feet in height, in which, as far as we have known them examined, no rock is found in site; they appear to consist entirely of gravel, clay, and boulders; gravel is a principal ingredient; the boulders consist of varieties of granite and gneiss, whose local or natural sites it would be curious to trace on the main land, whence they must undoubtedly have been either violently or gradually removed; in many places they are found embedded in a stiff blue clay; a good clay for making bricks is occasionally found, particularly about the centre of the island. This range of broken ground, generally speaking, may be said to constitute one-half, and the longitudinal northern half of the Island; the other, or southern half, speaking in equally general terms, consists of a vast plain, very level in its appearance, and not unlike a prairie, as viewed from some of the peaks of the northern ground; the width of this plain from the sea to the base of the hilly ground, varies from three to six miles, rising gently from the southern shore at the rate of, it may be, twenty feet per mile. It is this plain which remains chiefly uncultivated or unappropriated to any useful purpose; the other country to the north is in great part cleared and farmed, and the natural soil is sometimes rich, and always superior to that of the southern side, though this is not the main cause of its advanced state; neither shore can be called bold, for the Island in all its details is exempt from this title, but the northern side may be termed bold comparatively; it presents generally to the waters of the Sound, a steep gravel front of from 30 to 50 feet in height; on this shore there are several small harbours, none that I know of of great importance, Greenport and Sag-Harbor excepted; but they are at least available for farming purposes, and when coupled with the sheltered waters of the Sound, present facilities in this respect greatly superior to the southern shore. These harbours admit small craft carrying lumber and manure, and some of them offer shelter during stormy weather to the coasters which ply in the Sound; in general they are said to be of intricate entrance and possess but a minimum depth of water for such purposes: one or two small steamboats generally ply along the shore, during the summer, touching at all the different openings. There are but one or two villages, however, of any importance, nor is it easy to conceive under the present state of affairs that there ever should be more, since there is no back country of any extent to support them, and for the same reasons there is not a sufficient quantum of interest existing at any point on the island to induce, with any probability of success, the opening of competent thoroughfares behind; the length of the Island dissipates its strength, and thus its internal improvements, though they may be suggested from within, cannot be altogether perfected there, but must depend to a degree on extraneous assistance.

The southern shore on which lave the waters of the Atlantic, is peculiarly formed, so peculiarly that I can hardly expect to describe it intelligibly—this shore forms the extremity of the wide plain which I have already spoken of, and therefore this shore viewed from the sea appears quite low and flat; the waves of the Atlantic do not roll immediately upon the main-land of the island, but are separated from it by what the

Long Islanders term the "beach," which is a narrow bar of gravel, separate from the main shore, and elevated a few feet above the highest tides; within this bar and between it and the main land, (not a very appropriate term when speaking of an island, but we know of no better), lies, what on Long Island is termed, the bay; a shallow stripe of salt water from one to four miles in width, and which communicates with the ocean through various openings in the bar already mentioned; these openings constitute likewise the entrances to any harbours which exist on this side, and as may readily be conceived, do not afford very safe passage—the waves lash with great violence on this outer bar, and with great violence through these openings during gales, in proportion to their shallowness, and none of them are deep. I have been told that there exists another bar, just without the breakers, which, however, is always covered with water. Occasionally points of the main shore connect with the bar, and thus separate the inner waters into a series of small bays; on various points of these bays, landing places are formed for small sloops, and such are used for the same purpose as those on the Northern side, although not so extensively. The harbour is not so good, the entrances are not so safe; the navigation outside is completely open and unsheltered; and the risk and delay are immeasurably greater in consequence, than on the Sound. There are, therefore, no steamboats on this side: these causes will always render this side of the island, in every respect, less valuable for agricultural purposes than the Northern, until some artificial inland opening be made through the centre of the island, to which, while it shall be superior, in every respect, to the navigation, even on the Sound side, will enable both sides, and especially the Southern, to carry its supplies to market, at a rate admitting of competition with the more favoured lands bordering the Hudson, and which shall draw to it a population sufficiently dense, and, therefore, sufficiently enterprising, to furnish the means of making all the local and peculiar improvements, which in every section of the country are more or less necessary to its prosperity. To whom shall a Long Islander look at present for support to schemes of the most apparent and prudent advantage? Not certainly to the neighbouring proprietary; if he travel six miles back, he will find the social interests already changed; the men will have become Southern or Northern shore men, according as he is Northern or Southern himself. Their interests will embrace the shore which lies nearest to their properties; if he move laterally, he will find a new interest at every new landing place. This state of affairs can only be mended by the fortuitous interference of foreign interests—foreign as respects the island,—and such a beneficial interference to the Long Islander would be the Long Island Railroad. This road, which would form one branch of the great natural thoroughfare between Boston and New-York, would, independently of the var ous and tumultuous interests on the island, and independent of its support or its capital, open just such an inland communication as the island peculiarly requires. It would place its products, in point of distance and in point of cost, on an equality with the lands along the Hudson from the city; and inasmuch as it did this, it would offer an immediate and adequate encouragement to all the farmers on the island, to extend and improve their system of cultivation—to bring into play the unoccupied lands—to raise crops with a view to another market, not to their own support merely, or that of their neighborhood. Inasmuch, besides, as land any where along, the Hudson within equally available limits, is valued much higher than the same land on Long Island, from peculiar advantages which, hitherto, Long Island has been known not to possess, it will draw to the island the same description of productive capital, which elsewhere finds at present such advantageous employment, in furnishing the city with vegetables, with grains, with fruits, with poultry, and other productions of the same description. It would likewise draw towards it a certain description of the population of New-York, which must ever be increasing, and which can no where find so convenient or economical a vent; I mean the class of householders, who, originally from the country, or estimating justly the benefits of a country residence of a young family, desire to reside there, if not during the year, at least for a considerable portion of it, and who would have executed their desire, did any opportunity present itself sufficiently convenient, not to interfere with their particular pursuits. This class cannot escape across the Hudson; the distance is too great, and the nearest lands in consequence of the low grounds are not very healthy; neither can they escape on York island itself—the very rich have already pre-occupied that very convenient piece of ground. On Long Island, however, if the railroad were formed, they would find conveniences sufficient to induce them to connect themselves with its interests; the distance from New-York to Brooklyn is from ½ to ¾ of a mile—the ferry is rarely interrupted, even in winter; the railroad, as all railroads are, is peculiarly constant in its arrangements, and has already promoted its interests, by accommodating a similar class at Jamaica, and would doubtless, always be interested in accommodating such, aside from its transportation of the Boston travel; the island is peculiarly dry and healthy, and appropriate, especially along its centre line, to such purposes—however defective in respect of bold or grand scenery, it possesses many beautiful spots among its small hills, presenting confined but very pleasing and snugly sheltered situations for summer residences, and on the Northern side there are many views and openings towards the waters of the Sound, which are exceedingly picturesque. The picturesque, however, is not always the most convenient ground for a country house, and I am at present looking out for retreats for men of business, not wonders for men of taste.

The two best harbours on the island, Greenport and Sag Harbour, lie at its Eastern extremity. These harbours afford safe shelter for the largest class of vessels, in proof of which it is sufficient to say that the whale fishery forms their chief surport. Whichever of these harbours should be chosen as the terminus of the railroad, and Greenport would probably be the most convenient; it is not to be forgotten that during severe winters, when the bay of New-York is altogether closed to its own ships, this harbour might be used with advantage as a temporary discharging point for the city, and whence cargoes might as well be despatched abroad.

Our observations tend to prove that it is the want of ordinary facilities of communication with the city which has prevented this island from advancing so rapidly as by its position it ought to have done. Long Island is, indeed, at present, far behind the world about it; it cannot compete with the Hudson while it has not the same facilities of communication, and it cannot create these facilities within itself where its native interests are from its peculiar form so broken and diversified. A railroad would therefore be to it an immeasurable blessing, opening to it all the sources of profit which have so enriched the other lands around New-York; and these advantages would enable it in its turn to be of more benefit to the railroad, than at present any one would be willing to believe. We know that its lands, wherever opened and cultivated, have produced faithfully, and can compare, in this respect, with any grounds of equal extent in the neighbourhood of New-York. Very respectfully,

S. O.

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### *Steaming on Canals.*

We noticed a few weeks since, that a model of a steamboat with the propelling power on the principle of sculling a boat, had been brought to this country from England, by Mr. Strickland, and also spoke of its application to canal boats and, perhaps, to our packet ships. It is perhaps, premature to speculate on the great revolution which the success of the experiments made in England, and the consequent adoption of steam power on canals, would occasion to canal navigation in this country; but from the following notice that we find in the Manchester Guardian, we presume that the annexed description of an experiment made by the Novelty, as she is called, through the canals between London and Manchester, at the rate of about seven miles an hour, will be interesting to our readers.—*U. S. Gazette.*

"An iron steamboat, built by Mr. John Laird, of North Birkenhead, (under the inspection of Mr. F. B. Ogden, the United States Consul at Liverpool,) and fitted with the sculling propellers, was launched on the 7th inst. She is at present waiting for her boilers, and it is expected will be tried on the Mersey in the couse of next week. She is intended to be worked as a steam-tug, to tow ships upon the Delaware and Raritan Canal, (New Jersey,) which was completed in 1834, and is 42 miles in length. Her machinery is said to be of a new and improved construction, and not a tenth part of the weight of the machinery in general use, of equal power."

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" We have already stated, that the *Novelty* is the hull of an old canal boat. Her form, to those unacquanted with the build of these boats, will be understood when we state that her length is about seventy-four feet, with seven feet six inch beam; she is heavily constructed, and, when loaded, draws about two feet water. We noticed that her engine was high pressure and of four horses' power, supplied with steam from a small locomotive boiler. The boat is fitted with a species of paddles, already described, but perhaps better known as "Ericsson's propellers," in substitution of the side paddles, of the old steamers--which are constructed so as to propel, without raising a surge injurious to canal banks, and so as to pass through the narrow locks with ease and safety--objects hitherto unattained, and deemed impracticable. The main peculiarity of this invention is the construction of the paddle, so as to secure an action resembling that of a fish's tail,or of a perpetual sculling through the water. The difference between the operation of the propellers and that of the fish or double scull, is, that instead of the force being alternate from side to side, the propellers strokes upon the water are simultaneous. We before explained the construction of the paddle-boards, and the fact of their revolving in opposite directions. This is effected by the wheels or rings being fixed, one to a hollow shaft, and the other to a solid shaft, revolving within the hollow one; so that, although they move in opposite directions, they turn upon the same centre; each opponent paddle-board striking the water at the same time. The power from the engine is communicated by a crank at the solid shaft; a cog-wheel attached to the crank shaft works in gear with another cog wheel immediately under it, and the reversed action of the other propellers is obtained by gearing and an endless chain. As these propellers work with the greatest effect when submerged, no waste of power is incurred, and no shaking motion communicated to the boat. When in motion, with her propellers submerged, there is little to distinguish the *Novelty* from other canal boats, the old wooden funnel being retained; there being little smoke, as coke is the fuel consumed; the engine and boiler being out of sight, and the only variation in her form being the elongation and widening of the stern, about 14 inches, with the addition of a slight stage for the helmsman.

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### *Wooden Pavements.*

The experiment of wooden pavement seems to have been fairly tried in this city. We regard the success which has attended the efforts in Walnut street below Third, and in Chesnut above Fourth, as conclusive of the adaptation of that species of pavement to city streets. Of the duration, positive and comparative, of wooden pavements, we of course are not yet enabled to speak, but we may say that in several streets of our city, stone pavements have exhibited strong evidences of needing repairs in less time than the wooden pavement has been in use.

That part of the Chesnut street wooden pavement nearest to Fifth street, was, we know, in a bad situation for a considerable time; but this arose, we believe, from a want of proper knowledge of the best mode of putting it down and especially for want of some drain for the water falling upon it and soaking through between the blocks. The whole was taken up, relaid with care, and a drain made for carrying off the water; but especially were there stone gutters laid between the blocks and the curb stones. We are not sure but we shall some day see the gutters of our streets formed of cast iron, the upper surface cast in such a way as to form a drain for the water. We must enquire into the probable expense of such substitution for stone. The business of *street* making is as yet but little understood, but we hope that in a few years some substitute for the present wretched pebble pavement and brick gutters will be generally adopted. At present we know of nothing that can exceed the hemlock or locust blocks, and stone or iron gutters; and we believe that, with a little foresight and care in procuring a supply of timber at the right season, the streets may be thus paved at about twenty per cent. more than the pebble covering costs. The difference in comfort and wear and tear to horse and carriage, may be guessed by those who occasionally ride by the United States Bank. The difference in neatness of appearance and cleanliness is obvious to any one.—*U. S. Gaz. Phila.*

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### *Extract from a Letter, dated Crawfordville, Ga., August 13th.*

The Georgia Railroad is in successful operation to this place. The passenger cars arriving regularly every day from Augusta, (Sundays excepted) at 10 o'clock, A. M., and departing at a quarter to 11 o'clock, A. M., reaching Augusta at 4 o'clock, P. M.

The motion of the Locomotive and cars on most of the road is exceedingly smooth and easy; the only annoyance is the dust raised from the road by the very rapid motion of the cars, approaching frequently to near 30 miles an hour, and the black smoke of our pitch pine. There has scarcely anything happened that might bear the name of accident since operations commenced on the road.

There is but little doing in the way of freight at this season of the year, but we confidently look forward to a profitable business in that way when the new crop of cotton shall come in.

The road will certainly be completed to Greensboro, eighteen miles beyond this place, by Christmas next. Old Georgia, long incredulous, is at length wide awake to internal improvements.

We calculate on a good average crop of cotton, not more. The crop of corn good in many places. Wheat crop better this year than usual, &c.

J. E. M.

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*Philadelphia and Reading Railroad.*—We have in preparation a full description of this very interesting Road, which reflects the greatest credit upon its proprietors and engineers. Meanwhile, we would point out this as a Road well worth visiting; both by those who are in search of professional information, and by those who seek health and pleasure. The scenery along the Schuylkill—the tunnel and beautiful bridge, but particularly the approach to Reading, are either of them well worth a visit. This should be a favourite trip, both to Philadelphians and strangers. The most excellent accommodations to travellers are provided.

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*Erie and Sunbury Railroad.*—The different brigades of Engineers employed under the general supervision of Mr. Miller, as principal Engineer of the Sunbury and Erie Railroad, have been, ever since early in April, actively engaged in exploring a route for that important branch of internal improvement, in which Philadelphia has such a deep interest.—*U.S.Gaz.*

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*Important for Ladies.*—The Boston Times says: "Mr. J. Cutts Smith, of this city, has invented a key for tuning Piano-Fortes, which promises to be of great utility, and will enable ladies to tune their own Pianos, without the trouble and expense of procuring a person especially for that purpose. It is very simple in its construction, and will probably soon take the place of the old key altogether."

We think this is something like a watch key to regulate watches, without the trouble, &c. &c.

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*Gas Works.*—We have before us a handsome volume, containing reports of the trustees of the Philadelphia gas works to the councils, to which are added the reports of committees of councils prior to the establishment of the gas works, the report of S. N. Merrick, Esq. on the gas works of Europe, the ordinances of councils in relation to the works, the bye laws of the board, &c.—a valuable book of reference; and we may take occasion to say, that never was an undertaking carried on, from its commencement to its entire establishment, with greater success and fewer mistakes, than have marked the gas works of our city. The mission of Mr. Merrick to Europe was a most fortunate part of the work, and the results of his labors show him to have been a shrewd observer, as well as a skilful mechanic.—*U. S. Gazette.*

We should like very much to see a copy of Mr. Merrick's Report. We are pleased to learn that our neighbours are doing the thing in the proper manner.

# AMERICAN
# RAILROAD JOURNAL,
AND
# MECHANICS' MAGAZINE.

No. 6, Vol. I. New Series. ] SEPTEMBER 15, 1838. [ Whole No. 318. Vol. VII.

*Remarks on De Pambour's Formula of Locomotive Engines.*

To the Editors of the Railroad Journal.

GENTLEMEN,—In your Journal of the 1st, I observe a communication from C. E Detmold, Esq., establishing (to his satisfaction) the general correctness of De Pambour's formula of Locomotive Engines.

In doing this, Mr. Detmold first charges the undersigned with having "obtained a monstrous result," through the wrong application of the formula in a certain case; and then applies (rightly of course) to the same case, the formula for determining the maximum load—and the velocity with which the engine will move that load. The result is, that this Engine, (the VESTA, according to his calculation) will draw 191·7 tons, at a velocity of 13·5 miles per hour.

In making these computations, Mr. Detmold has taken the effective pressure per square inch in the boiler at 58 lbs. De Pambour says it was 56·5lbs. at the time of this experiment. He has also "taken the ratio of the volume of steam at the total pressure at the time of the experiment, to the volume of water that produced it, at 414"—the table given by De Pambour makes the ratio 393, when the effective pressure is 58lbs. and 400 when it is 66·5lbs. per square inch in the boiler. Mr. Detmold also says, "and diameter of cylinder ·9375 feet"—now De Pambour says the VESTA's cylinders are 11⅛ inches diameter, equal to ·92708+ feet. We would gladly have spared Mr. Detmold's feelings, by passing these inaccuracies in silence, did they not affect the statements given below.

If we now take the true results of the formula, as *applied* by Mr Detmold, we have for the maximum load of this engine 186 4 tons, at a velocity of ·68776+feet, equal to 13·03 miles per hour; while the experiment shows that the engine drew 189 tons at 3 miles per hour; in other words, the formula gives, in this instance, a velocity about 4⅓ times as great as the engine did attain with *the given* load. Is it possible that Mr. Detmold thinks that this "result corresponds very nearly to that of the actual experiment?" Does he consider this as "close a corroboration as the most fastidious could require?" If so, we must continue to differ on this point with him, and the "*many others*," even though we do it at the risk of being thought somewhat "*fastidious*."

Again, Mr. Detmold says "the velocity of the engine may be reduced below this point," (meaning the velocity which the formula gives for a maximum load) "but certainly *the load cannot be increased beyond its maximum.*

We give below, the results of all the experiments made by De Pambour with this engine, when the load was so great that it could not reach a speed of 13·03 miles per hour, even though the water in the tender was, in two instances, lukewarm. They are as follows:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 129 tons | 12·10 | miles per | hour | 55lbs. effec. pres. | per sq. | inch in | boiler. |
| 183 " | 3 25 | " | " | 58 " | " | " | " |
| 189 " | 3·00 | " | " | 56·5 | " | " | " |

Now 186·4 tons is the maximum load, according to the formula, for all velocities up to 13·03 miles per hour, when the effective pressure in the boiler is 56·5lbs. per square inch, and 12·10 miles per hour is below the velocity which the formula gives for the maximum load with the effective pressure of 55lbs. per square inch.

*Query.*—If this engine can draw 186·4 tons at 13 03 miles per hour, (as per results of formula) how does it happen, that at 12 10 miles per hour, under very favorable circumstances, it can only draw 129 tons?" Or 184 tons, at 3·26 miles per hour? Or, that it can move 189 tons at all?

*Query 2d.*—If, (according to the formula) this engine can draw the same load at 13 03 miles per hour, that it can draw at any less velocity; then how does it happen, that with every reduction of velocity, even to the lowest tried, there is a corresponding increase of load, "*beyond its maximum*" in one instance? Can Mr. Detmold see "*no great difference* here between the result of the formula and that of the experiment?" Or, will he say "these results no longer suit the question?"

If he will take the trouble to compare all De Pambour's experiments where the engine was in good order, the regulator entirely open, and the load less than a maximum by the formula, he will find that the discrepancy between the results of the formula, and the experiments, falls below 10 per cent. of the load drawn, only in about $\frac{1}{4}$ of the whole number; and in about $\frac{1}{5}$ it is between 10 and 20 per cent.; about $\frac{1}{4}$ between 20 and 40 per cent.; $\frac{1}{6}$ between 40 and 100 per cent.; and in the remainder, (about $\frac{1}{8}$,) the discrepancy is over 100 per cent.

And with a little additional trouble, he will find also that De Pambour, in one of his "*practical tables*," has made the same use of the formula that we did in the case of the engine Vesta: that is to say, he "continued the equation beyond the point where P is equal to R."

Again: Mr. Detmold has applied De Pambour's formula to an imaginary case, (Mr. Johnson's supposed engine,) and finds that the engine, with 70 lbs. total pressure per square inch, will draw 336 tons: and then, by changing the equation, draws therefrom the resistance of this load when referred to the pistons, which he finds to be 69·9 lbs per square inch. *Wonderful coincidence!*—and still more wonderful, that Mr. Detmold, (judging from his communication) should have made two solutions of the same simple equation so nearly agree. And this too, he calls "a close corroboration of theory by practice;"—a novel way truly, of comparing theory and practice.

It is not difficult to see how Mr. Detmold arrives at the conclusion that *he* has "sufficiently proved the general correctness of De Pambour's formula!" But it would be strange indeed, if his *reasoning* should lead many others to the same mysterious conclusion.

Perhaps Mr. Detmold may be induced, (for the special benefit of the profession) to "pursue this subject" somewhat "farther." No doubt but Mr. Johnson already feels himself under great obligations for the very valuable suggestions in regard to his "tabular statement." And for aught we know, there may be "many others," whose obligations do not fall a whit below Mr. Johnson's.

Before closing, we wish to say, that we yield to none in admiring the "talent, industry," and skill of De Pambour, who, born to rank and affluence, has unsparingly devoted time and money to the patient investigation of a subject, most deeply interesting to every philanthropist. Perhaps no other man in the wide world, would, in the like circumstances, have accomplished so much. At any rate, among the thousands similarly situated, he alone seems to have been undaunted by the magnitude and difficulty of this subject. Nevertheless, it should not be forgotten, that he does not "pretend to have produced a perfect work." He says, "We thought our work would at last have this result, to call the public attention on the subject. We shall feel happy if we have succeeded in some of our researches; and happy also, if others, in correcting our errors, shall at least elucidate the facts upon which we have called their attention."

Yours truly,

William H. Talcott.

*Cuba, Aug. 2?, 1838.*

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***First Annual Report of the President and Engineer-in-Chief of the Central Railroad and Banking Company of Georgia.*** L. O. Reynolds, Chief Engineer.

(Continued from page 151.)

The length of the northern route, I think, may with safety be put down at 200 miles; and it now appears, that if the southern route, is adhered to, we shall be under the necessity of bending down the country, and gaining the valley of the Ocmulgee as low down as Tarversville. Indeed, I have no doubt the interest of the Company would be promoted by such a course. It follows then, that the line would be nearly or quite as long as the northern route. On the accompanying map, I have marked both routes in red lines, as nearly as the data in my possession will enable me to, and you will perceive that the southern measures on the map, are even longer than the northern.

I think I can safely say that no eligible route south of a straight and direct line, can be obtained less than 190 miles long; and I think it very probable that distance would be exceeded.

In regard to the difference in the cost of the two routes, it is impossible with the data in my possession to form an estimate entitled to confidence. I have no doubt, however, that the average cost per mile of the northern route, (provided grades of 30 feet per mile be admitted,) would be less than that of the southern."

*The data on which the southern route was recommended, so far as I have any knowledge of it, has been given in a previous part of this report.*

"A large portion of the northern, as well as the southern route, particularly on the north side of the Ogechee, was run in long random lines, as time would not then permit us to seek out the best railroad line, and is therefore equally susceptible of improvement."

I feel confident that the distance may be reduced to 200 miles, if not less, and though we know that grades which shall not exceed $21\frac{12}{100}$ feet per mile, are attainable throughout the whole route, without any extraordinary difficulties, yet by increasing the maximum to 30 feet, an immense saving can be made.

You ask me to say whether such a change would be more advantageous to the northern than the southern route.

I think a greater saving of expense would result from such an increase of grade on the northern than the southern route, for the following reasons: On the southern route, the most unfavourable feature in the topography of the country, is the low level in which the streams run, compared with the elevation of the table land between them.

This table land generally falls off very abruptly near the stream, and consequently involves a deep cut and heavy embankment in the crossing. The distance from the high lands on either side to the stream generally not being sufficient to effect a great saving by an increase of grades.

On the northern route, the main difficulties consist in passing two summits; we are obliged to avail ourselves of the valleys of streams running down from these summits, for the purpose of ascent, and to commence the ascent at a greater distance from the summit, in proportion as the rate grade is lessened.

The small streams generally have a rapid fall for a short distance from their head, and then have a more gentle descent. The steeper our grade therefore, the sooner we are able to make it coincide with the natural slope of the valley, while the more gradually we depart from a level, the longer our line is kept away from the stream, and the greater the elevation at which the branches and ravines putting into it have to be crossed.

Such a change of grade would of course be advantageous on either route, so far as cost is concerned; and I am of opinion that it would be advisable whichever route is pursued to adopt it.

The maximum grade on the Charleston and Hamburgh road, is 37 feet per mile. Their engines drag trains of 100 tons weight, and perform the distance (136 miles) both ways in three days.

Their passenger trains perform the whole distance of the road in 8 to 10 hours.

You ask 'what points on the northern route should be examined, before a just and proper contrast of the two could be made—and how long it would take to make such examination?'

The main difficulty in making a comparison of the two routes, is a want of information in relation to the southern, for we have as yet designated no entire route by actual survey, with which to compare the northern, either in point of cost or distance. On the northern, we know the utmost extent of the difficulties that we may be obliged to encounter; the only question is, how far those difficulties can be reduced. To ascertain this, I would re-examine the whole country from the mouth of Big Sandy Creek to the Sandersville summit, This should be done thoroughly and carefully, as there are several routes claiming examination, and would require at least two months. I would then make an exploration of the valleys of Commissioners and Walnut Creeks, which would probably prove successful, provided grades of 30 feet per mile were admitted, and effect a saving of 5 or 6 miles in distance, as well as to go into a more populous section of country than to follow the valley of Big Sandy Creek. These surveys with some examinations in the County of Scriven would afford all the information that could be obtained short of a location of the line, and would occupy about five months.

A full and well appointed party would be required for the performance of this duty, at an expense of about $600 per month.

You ask 'could the proper data be obtained for a determination in time to put under contract 30 to 40 miles on either route by the 1st of November next?

I have no hesitation in saying that it could not, for the *proper data* for a determination would require not only the examination above mentioned on the northern route, but also an experimental survey approximating to a location for the whole distance from the Canouche River to Macon, with estimates of the same. This could not be done before the 1st of September, and as locating is a slow operation requiring much care and exactness, we could not count on having 40 miles ready for contract in less than three months after the decision was made. This would bring us into the month of December, if not January.

There are, then, three alternatives presented to the Board:—1st. To adhere to their former decision, adopting the southern route, and proceed with the locations now going on, as far as the Ohoopee; from thence continue an experimental line to Macon.—2d. To abandon that route at once—take the northern, and locate a portion of it in time for contract by the 1st of November.—3d. To suspend their decision until a full and proper examination of both routes throughout be made, with all the improvements they are susceptible of. This, with the estimates and calculations necessary, would preclude a possibility of getting any portion of the line ready in time for active operations next winter.

Aside from the disadvantages attending the loss of the next working season, the last would doubtless be the most judicious course. What the effect and consequences of such a delay would be, the Board can as well judge as myself.

If the decision is to be made between the first and second alternatives, my opinion would be in favor of the second. The reasons are, the advantages before enumerated of the northern over the southern route, and the additional consideration that we have a favourable country for the distance of 125 miles to Sandersville. If we complete the road thus far, there can be no doubt of our being able to make such a demonstration of its utility, as to enable us to carry it through any difficulties we may find beyond that point, whatever may be the vicissitudes of the times.

On the other hand, we encounter a most expensive section at the very threshold of the southern route. The first six miles beyond the Ogechee River will probably cost $120,000, while this sum will build three times the distance on the northern route.

I have no hesitation in saying, that by yielding to grades of 30 feet per mile, the northern route may at once be adopted at less hazard, than to put under contract, with the knowledge we now have or shall be able to obtain before September, the line from the Ogechee to the Ohoopee. It is certain that our information is more full in relation to the northern than the southern route; for the latter beyond the Ohoopee is still in a great degree left to conjecture."

The Board of Directors passed a resolution, directing 30 miles on each route to be located; this was accomplished, and profiles with careful estimates made of the same. The result shewed a large difference in cost in favor of the northern route; and on the 1st of August, 9 miles of the latter were put under contract—the Board having previously unanimously resolved to abandon the southern and adopt the northern route. On the first day of October, a further distance of 25 miles was let. On the 6th day of November, 9 miles On the 3d of January, 9 miles; and on the 5th of the last month 10 miles, making 62 miles, and in all 79 from the depot in Savannah. Of this distance, 67 miles are graded. The superstructure laid 26 miles from the City, to which point our engines now run. Contacts for laying the rails have been extended 51 miles, and for furnishing the timber a further distance of 9 miles.

We have graded 51 miles of the road within this last nine months, and shall be prepared in three months from this time, to extend our contracts for grading 110 miles from this City.

I will close this report with a brief description of the road as far as it is definitely located.

In the southwestern part of the City is our Depot, a tract of 5 acres, which was bestowed on the Company by the City Council of Savannah.

The line leaves this depot, and continues straight N. 77° 10′ W. for 13 miles—then curving slightly to the left on a radius of 150,000 ft., it approaches within a mile and a half of the Ogechee—then bending to the right on a curve of 5,000 feet radius, it follows the general direction of that river; and at a mean distance of about 3 miles from it, through the flat lands of Effingham County, until it reaches the County of Scriven—then taking the hammocks bordering on the River Swamp, to avoid the undulating surface of the pine lands in this county before spoken of, it follows them to Brinson's Mill Creek—then takes the valley of this Creek which leads out from the river, having passed around Paramour Hill, and across Buck Head Creek, the line again resumes the river flats, and continues over them through the County of Burke—crossing the Ogechee at the point before mentioned about 12 miles from Louisville. The locations have been extended about 5 miles up Williamson's Swamp in Jefferson County.

The allignment of the road to a point in Burke County, 83 miles from the depot, consists of 22 straight lines of the aggregate length of 65 miles and 771 feet, and 21 curves of the aggregate length of 16 miles and 4,509 feet—the smallest of the latter on a radius of 2,000 feet. Curves of this sharpness occurring in only three instances, and for short distances.

The aggregate for the deflection is 524° 28′, or a little less than a circle and a half.

The vertical arrangement comprises 16 levels, and 81 slope grades, which may be classed as follows viz:

| | | | | |
|---|---|---|---|---|
| Level, | 13 | miles | 200 | Feet, |
| Inclination of 5 feet per mile and under | 25 | " | 4300 | " |
| Over 5 feet and under 10 feet | 11 | " | 4220 | " |
| Over 10 feet and under 15 feet | 7 | " | 2240 | " |
| Over 15 feet and under 20 feet | 6 | " | 4320 | " |
| Over 20 feet and under 25 feet | 6 | " | 2120 | " |
| Over 25 feet and under 30 feet, | 11 | " | 3720 | " |
| Total, | 83 | miles, | | |

The bottom width of the excavations is 25 feet, with slopes of 150 base to 100 vertical, except in compact clay and sand, when a slope of 45° is given.

The top width of the embankments is 15 feet, with slopes of 150 to 100.

All trees are felled for a width of 165 feet. The culverts and bridges are made of timber, there being no stone for the purpose within reach.

SUPERSTRUCTURE.

The plan of superstructure of this road, differs materially from that most common where the flat plate rail is used.

Cross sleepers are first bedded in the ground and rammed solid; their upper surfaces being level with the grade of the road—string pieces, 6 inches deep, and one foot broad, are then laid flat-wise on the sleepers, and trenailed to them with 1½ inch trenails, their centres being 5 feet asunder, (the width of the track,) and the ground rammed under them, affording a continuous bearing. On the top, and in the centre of these string pieces, is placed a small scantling or lath, 2+3 inches, which is surmounted by the plate rail of iron 3 inches wide by ¾ inch thick, weighing 30¼ tons to the mile. The iron is confined by spikes 7 inches long, passing through the lath into the string piece. Wrought iron splicing plates ¼ inch thick are placed under the joinings of the iron bars, and confined by spikes passing through them. The above arrangement of superstructure was introduced by the former Chief Engineer of the Company, and having had an opportunity of giving it a fair trial I am satisfied of its efficiency.

An embankment containing about 200,000 cubic yards has been made, to pass our road over the marsh forming the valley of Musgrove Creek, in the first mile from the City. The greater portion of the material for this embankment, has been transported from a point about 3½ miles distant, in Cars moved by Locomotive Engines. Upwards of *one hundred thousand tons burthen* has passed over this portion of the road, within the last 12 months, besides the return trips of the empty cars of 12 trains per day.

This is equal to the regular business of three years, and the track, with the exception of some points where it was laid on fresh embankments, is now in good order.

In relation to the cost of the road, I have not the data for making a correct statement of the first 17 miles from the City, as it has been done partly by contract and partly on the Company's account, and the accounts of disbursements were not kept in this office.

The cost of the 51 miles beyond, may be stated as follows:

| | | |
|---|---|---|
| Grading, including excavation, embankment, clearing, grubbing, bridges and culverts, 51 miles, . . | | $113 484 82 |
| Average for grading. . . . | $2225 19 | |
| Laying track 9 miles, . . . . . . . . . | | 6 300 00 |
| Furnishing timber 20 miles, . . . . . | | 16 002 00 |
| | | $135 786 82 |

The above is exclusive of iron which, including plates and spikes, cost about $2,000 per mile, and also exclusive of cost of engineering.

For the distance of 50 miles from the end of our present contracts, the country is as favourable for the construction of the road as the 51 miles above spoken of, and it may be built at as small cost. The line is free from any objectional curvatures, and the profile presents a surface of most remarkable uniformity, and although some portions of the line hence to Macon will be more expensive—a considerable part of it is equally favourable.

A quantity of iron has been ordered and paid for, sufficient to extend the track 83 miles from the City, some of which has been shipped for this port.

Surveys are now in progress in the vicinity of Macon, for the purpose of ascertaining whether a route is practicable down the valley of Walnut Creek with a maximum grade of 30 feet per mile, and so far as they have progressed the result is favourable.

I am, very respectfully, your obd't serv't,

L. O. REYNOLDS, *Chief-Engineer.*

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## *Description of the Construction of the First Division of the Long Island Railroad, with Remarks. By an* ENGINEER.

### INTRODUCTION.

THE modes of construction followed on works actually completed, and the cost of the materials actually used, are items of information, with which every engineer desires to be acquainted. Few engineers have the opportunity to collect such information personally, by visiting and examining in detail the different roads in operation, nor would such an examination prove very satisfactory, unless accompanied with that explanation of the circumstances, which only those who superintended or were connected with the work, can give. A short description of every work, prepared after its completion by the engineer, and while all the circumstances were fresh in his recollection, would supply this want, and would probably be always well received by the profession; but the Chief Engineer of a work is rarely able to devote the necessary time to this purpose. In view, however, of the reciprocal benefit which would ensue by the encouragement of such a rule, one or other of the assistants, or the superintendent might undertake the task, and if the result should not be as complete as it would have been, had it emanated directly from the Chief Engineer, there could doubtless always be presented a fund of valuable practical information, sufficiently extensive to render it acceptable to the profession.

Under this belief, the following account of the First Division of the Long Island Railroad has been prepared. The collector, although connected with the engineer department of the first division from the commencement of the work to its completion, has not been able to make the account so complete in respect of cost as is desirable, from the fact that many of the payments were made by officers of the company, whose leisure has not permitted them to furnish him with the details in such a way as to enable him to connect them satisfactorily with the other divisions of expenditure possessed by himself. The graduation of the work referred to, was commenced in May 1836; it was opened for travel in March 1837. The suggestions at the end of the account (and which it will be perceived are directed rather to those interested in this particular road) are submitted with deference.

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THE Jamaica Railroad and the Long Island Railroad, although forming so far as is concerned, one continuous track, are distinct properties. The Jamaica Railroad comprehends that part of the road between Brooklyn and Jamaica. The Long Island Railroad comprehends from Jamaica to the eastern extremity of Long Island. The Long Island Railroad Company by their charter, were empowered to construct a road from Brooklyn to Greenport, but as the most feasible ground as far as Jamaica was already occupied by the Jamaica Railroad, an arrangement was made, whereby the Jamaica Railroad was rented to the other Company for a term of 40 years, at a yearly rent of, I believe, 9 per cent. on its expenditures. The Long Island Railroad, therefore, commences under this arrangement at Jamaica, and it is the portion of this road finished and in operation, or what has been termed the first division, stretching from Jamaica to a point opposite Jerico, now termed Hicksville, that I propose to describe.

The Long Island Railroad then branches from the Jamaica Railroad at Jamaica, at a point 10·83 miles from the South ferry, Brooklyn; the curve which at this point connects the terminus of the Jamaica Railroad with the due course of the 1st division of the Long Island road, has a radius of 5730 feet—the length of curvature is about 1100 feet, and this comprehends all the curvature on this division—the remainder is straight.

The entire length of the division is 15·34 miles, of which the equivalents of curved and straight line are respectively 0·21 miles, and 15·13 miles. The profile will show the different inclinations, which are likewise exhibited condensed in the following table:—

INCLINATION.

| Rates per mile in Feet O. or level. | Rise Miles dec. | Fall Miles dec. | Total Miles dec. |
|---|---|---|---|
| 5·28 | 1·89 | | 5·24 |
| 7·92 | 1·01 | | 1·89 |
| 10·56 | 2·84 | 0·19 | 1·01 |
| 13·20 | 3·60 | | 3·03 |
| 15·84 | 0·57 | | 3·60 |
| | | | 0·57 |
| | 9·91 | 0·19 | 15·34 |

The following table will show the position of these inclinations without reference to the profile. The stations are 100 feet apart.

| From Station | To Station (A) | Rate per 100 feet. Feet | Rate per mile Miles. | Elev. of 2d column (A) about stat. O. Feet. | Distance of 2d column from stat. O. Miles. | Elev. of 2d column above high water Brooklyn Feet. | Distance of 2d column from Brooklyn. Miles. |
|---|---|---|---|---|---|---|---|
| 0 | 0 | | | 0· | | 44· | 10·83 |
| 0 | 20 | 0·20 | 10·56 | 4· | 0·38 | 48· | 11·21 |
| 20 | 70 | 0·00 | 0·00 | 4· | 1·32 | 48· | 12·15 |
| 70 | 80 | 0·20 | 10·56 | 2· | 1·51 | 46 | 12·34 |
| 80 | 110 | 0·30 | 15·84 | 11· | 2·08 | 55 | 12·91 |
| 110 | 240 | 0·20 | 10·56 | 37· | 4·54 | 81· | 15·37 |
| 240 | 340 | 0·10 | 5·28 | 47· | 6·44 | 91· | 17·27 |
| 340 | 410 | 0·00 | 0·00 | 47· | 7·76 | 91· | 18·59 |
| 410 | 463 | 0·15 | 7·92 | 54·95 | 8·77 | 98·95 | 18·60 |
| 463 | 620 | 0·00 | 0·00 | 54·95 | 11·74 | 98·95 | 22·57 |
| 620 | 810 | 0·25 | 13·20 | 102·45 | 15·34 | 145·45 | 26·17 |

### WIDTH.

The road is graded for a double track; the width of roadway is 28 feet in excavations and embankments. The stuff excavated consisted of sand and gravel; the sand was sometimes found pure, but more frequently intermixed. In one of the excavations near Hicksville, small veins of clay occurred frequently, crossing the track. These when they appeared on the road bed, were removed to a depth of 18 inches, and replaced by gravel. At the extremities of the excavations where the top soil and the road bed meet, the same process was pursued. The entire plain on which the division rests is a gravel formation exceedingly open and pervious to water; the surface water, or drainage of the country, escapes principally in this way. There are various hollows or depressions on the plain, with directions towards tide water, but so little of the surface water passes off ordinarily by the openings, that the natural sod is not broken, and there are no water courses apparent: this fact was taken advantage of in draining the railroad; pits were dug occasionally in the excavations into which the side drains were directed, and the unusual quantities of water produced during the spring, by the sudden melting of the winter snows, was thus easily carried off, nor did the water accumulate or overflow in the pits; these pits never reached the under current of fresh water, which evidently flows from the hilly side of the island to the sea, and from which the islanders derive their supplies for domestic purposes. This water is found at the Jamaica depot 28 feet below the road bed, but the road bed occurring in cutting there of about 6 feet in depth, it may be said to be 34 feet below the general surface of the plain at Jamaica. The top of the Jamaica well is about 45 feet above high water at Brooklyn; the bottom, or supply water of which we are speaking, is thus 17 feet above the sea. The well at the Hicksville depot is 72 feet in depth; the top of the well is about 147 feet above high water, and the bottom or water of the well is therefore about 75 feet above the sea. The Jamaica well, however, is distant from the salt water in the bay, only about 3 miles, while the Hicksville well is distant probably 10 miles: from these data, the descent of this underground flow, percolating through the gravel formation towards the sea, would be estimated at about 7 feet per mile.

### SLOPES.

The side slopes in excavations and embankments, incline in the ratio of 1½ horizontal to 1 perpendicular: this slope may be termed the minimum or sand excavations. I had an opportunity of trying the natural slope of gravel in an excavation of 40 feet in depth on the Boston and Providence Railroad; the gravel was very loose and free, consequently no picking was found necessary; the stuff rolled freely down to the feet of the laborers as the excavation proceeded; the side slopes formed of themselves with a little trimming at top. While the excavation was in progress, I tried with the level, the natural inclination of these side slopes, before they had been trimmed or touched, and after allowing them to stand about eight days exposed to a June sun, whereby any moisture was removed, and the particles of gravel being perfectly dry, could not but have attained their natural position: under such circumstances, I found the slope to exceed by a small fraction, the proportion of 1½ to 1. In some experiments, on the flow of sand through tubes, as detailed in a late Journal of the Franklin Institute, the experimenter gives from 30° to 35° as the natural inclination of sand, equal to about 2 to 1; probably the sand experimented on was finer and drier throughout than the sand generally found in the quarry, or the quantities experimented on may have been too minute to admit of very correct results. On the slopes tested by one, there would probably be only 3 or 4 inches of the sand on the surface entirely free from moisture. All sands and gravels found in their natural beds are combined with a certain degree of moisture and when this does not occur in excess, so as to appear as water, it renders them, as every one must have observed, more tenacious or solid than if they were entirely free from it: the slopes of sand of this description, will not therefore have attained their maximum until lengthened exposure has allowed the heat to penetrate to its maximum depth, and consequently, the dry crust or surface of dry sand to have reached its limit: this depth, however, is never great. These side slopes, except in some of the excavations finished during the winter months, were very neatly trimmed and finished by the contractors. In one of the excavations, the slopes were covered with the soil which had been previously removed from the surface of the excavation; they were then sown with grass seed; the seed speedily rooted, and these are the only slopes which retain the figure given, or possess now any thing like a regular appearance.

#### DITCHES.

Ditches were opened on each side of the roadway by the contractors for the graduation, where the graduation was finished before the commencement of winter; where the graduation was finished during the winter months, the opening of the ditches, in consequence of the great expense attending excavation in winter, was delayed until the ensuing spring: the general suspension of public works, however, which occurred then in consequence of the disastrous state of commercial affairs, deprived the engineer of the opportunity of perfecting them. The manner in which they were formed, and the dimensions, so far as completed, will be understood by reference to the cross section of the finished roadway in cutting (fig. 1.)* There being but one track laid in the meantime, and that on the south side of the centre line, there remains considerable unoccupied space on the north side, which is taken advantage of to increase the dimensions of the drain on that side. On the south side, the space between the outer rail, and the foot of the slope, is 6 feet: between the extreme end of the sleeper, and the foot of the slope, from 4½ to 5 feet: this space, when the ends of the sleepers have been sufficiently covered, admits of drainage of only one foot in depth, estimating from the graded surface of the road bed; estimating from the top of the sleeper about 1 foot 4 inches; the sleepers average 7 inches in depth; we have, therefore, when the ground sill is single, and 3 inches thick, a difference of 6 inches between the bottom of the ground sill and the bottom of the side drain: when the ground sill is 1 inch in depth, a difference of 5 inches; when the ground sill is double throughout, or when with the single ground sill, additional pieces occur, as at the junctions of the sills of the rails, a difference of two inches On the north side of the road, the drain is two feet in depth. These drains, where the side slopes have not been soiled, easily fill up, and require frequent renewing: the sand and gravel, of which the side slopes are formed, being very easily displaced. On the tops of the excavations, and within the fences, small drains, or cut waters, are formed, the stuff or turf excavated from which, is thrown up as a small mound on the outside; this prevents the surface water from the fields from running down the slopes.

* The Engravings referred to, will appear in our next number.

### PRICES OF EXCAVATION.

The prices of graduation were for the lower half of the division, 17 cents per cubic yard; excavation and transportation for the upper half, 18 cents per cubic yard. These were the contract prices, and so far as the work was completed without delay during the summer months, they proved amply sufficient. A considerable portion of the graduation was, however, delayed many months by unforeseen circumstances, and a considerable portion completed during the winter of 1836–7; for such portions additional allowances were made, varying with the amount of additional labor employed. The following list of prices were found to approximate very nearly to the truth, when ordinary labor averaged a dollar per day.

### COST OF EXCAVATION OF GRAVEL OR SAND.

| Transportation in ft. | Temporary Railroad and Cars. | Carts. |
|---|---|---|
| 500 | | 14 cents. |
| 800 | | 17 |
| 1000 | 17 cents. | 19 |
| 1500 | 19 | 20 |
| 2000 | 21 | 23 |
| 2500 | 22 | 25 |
| 3000 | 23½ | 28 |
| 3500 | 25 | 31 |
| 4000 | 26½ | 34 |
| 5000 | 28 | 38 |

For the year 1835 this scale would have been two cents less per cubic yard; the prices must of course be somewhat modified by the quantities of earth to be removed.

### FENCES.

The fences are placed at least eight feet beyond the top of the slopes in excavations or bottom of the slopes on embankments—the fence is uniformly a post and rail fence—the posts five feet in height, and distant eleven feet apart—the rails four to each post; the fencing was done for $1 25 and $1 50 per panel of eleven feet, the contractors providing every thing.

### FOUNDATION.

The graduation being finished according to the dimensions described, and all earths removed from the road-bed other than gravel, and replaced by gravel, no further preparation was made for the foundation of the superstructure; the foundation, therefore, on which the superstructure rested consisted throughout of gravel or sand.

### LAYING.

Ground sills were laid throughout; on the greater part of the road, and universally on the embankments, double planks were laid for ground sills, consisting of three inch planks laid the one above the other, and breaking joints (see figures 2, 3 and 5, D): where single planks were laid, they consisted of either three or four inch planks, and in this case additional pieces were laid at the points where the planks met, and also at the points where a junction of rails occurred: in the first instance, viz., where the planks met, the additional pieces consisted either of a piece of four feet in length, laid below, and so as to receive two feet of each plank, as represented at A fig. 2 and 3; or of two separate pieces of about three feet in length, one laid below the end of each plank and at right angles to its directions as represented at B, (fig. 2 and 3). In the second instance, viz., when the *rails* met, two additional pieces of plank were laid, one on each side of the ground sills, of three feet in length each, as represented at C (fig. 2 and 3), thus affording additional bearing to the junction sleepers. In either case, whether of double or single plank, the sills were so laid that the surface, when perfected, should be two inches below the original grade, or surface of the road-bed; small trenches were therefore dug in the first place to receive the plank of depth to correspond with the depth of plank and data above given, varying, however, occasionally to the extent of an inch, so as to comprehend different classes of sleepers. The bottom of this trench was neatly smoothed, and the plank being laid in it, the gravel was rammed along the sides, so as to equalize as much as possible the bed throughout; the plank itself was then rammed thoroughly with wooden rams, of probably 30lbs. weight, such as are used by paviers in consolidating the stones of causeways in public streets; every inch of the plank was slowly submitted to this process, and it was easy to know as the workman advanced, from the sound of the blow, whether the plank rested solidly on its gravel foundation. The ground sills having been thus prepared, stakes were driven to the grade line of the surface of the sleepers, varying with the different parcels of sleepers from six to eight inches above the ground sills.

### SLEEPERS.

The sleepers having been laid in their proper places, and with solid beds, the heaviest sleepers placed at the points of junction of the rails, the surface of the sleepers was prepared for the rail; this was done by paring the sleeper with an ordinary carpenter's adze very neatly, until the proper size was attained; during the process, a straight edge of the length of the rail (15 feet) was frequently applied, and all the sleepers cut for either rail, so as to correspond correctly with this test and grade *line;* there was, therefore,no moving or raising the foundation after its first and best preparation; its uniform solidity was thus far secured; neither were the individual sleepers allowed to be raised from the ground sills, by placing slips of wood or shingles beneath them. When the workmen by accident or carelessness pared or cut from the surface of the sleepers too much, so that a space existed between the straight line and that surface, the sleeper was removed, and replaced by a deeper. The sleepers having been thus prepared, stakes for the alignement were correctly given, and the laying of the rails proceeded next; in the process of cutting the sleepers, the junction sleepers had been cut deeper than the others, to receive the plate or chair, which is laid below the rail only at these points; the vertical position of the plates is therefore correctly adjusted in that process; they are, however, left loose until the rails have been laid in their places and approximated to the alignement of the load; the rails on either side being adjusted, the spikes are driven into the junction plates, the alignement of the rails is then further approximated; the spikes are now driven to about half their depth on the intervening sleepers; the alignement of the rail is then further corrected; the spikes are now driven home, the direction of the rails perfected, and the junctions examined and corrected, where necessary; the track is next filled in with gravel, covering the sleepers to the depth of about one inch; the ends of the sleepers are covered to the same depth; the ditches are now examined and cleaned out again, where necessary, by the contractor, for the laying, and the road is considered fit for travel. The laying of the superstructure was contracted for, at \$2 62½ per rod; it was not completed, however, for this price, having been partly laid during the winter months, when the hardening of the ground by the frost greatly increased the amount of labor necessary, as well as greatly reduced its value when finished, since no winter work can be so permanent or perfect as that which is done during summer. It may be added, that in consequence of this contingent and extraordinary expense, affecting more or less all the operations on this division, I am unable to give so useful a return of the cost, as otherwise would have been possible, since the actual cost in this instance, if it could be given, would form no criterion or guide in the construction of similar works. All the prices will be given which are not affected by this contingency.

## CHAIRS.

It has been mentioned that plates, or chairs, were laid only at the points of junction of the rails; the first mile of the road is an exception to this remark: there, an additional plate was laid at the centre of the rail, this additional plate was intended to allow for, and secure the free contraction or expansion of the rail, with the varying temperatures of summer and winter; the same variation was afterwards provided for at a less expense, though probably not so well, by a single plate. Fig. 9 is a cross section, exhibiting the mode in which the chairs receive the rail on all the plates used; the dimensions are marked in inches on the figure; fig. 6 exhibits the form in plan of the intervening plate spoken of, and which, as there were five sleepers to every rail, did not occur precisely at the centre of the rail, but at the third sleeper, nine feet from the one end of the rail, and six feet from the other; the holes *a a a a*, receive the spikes, and secure the rail to the chair; the small projections *b b*, are level with the sides or deepest portion of the chair (see fig. 9): these projections correspond with notches cut in the rail, of the same form as those represented at the end of the rail in fig. 11, except that for the chair in question, they occur near the centre of the rail, and in this case the rail was not cut at its end. In laying the rail, the notches just described fitted into these projections, and secured the rail at this point; a sufficient allowance, however, being always made while laying, for the expansion of the rail, and the junction plates in this case being quite smooth, the rail was at liberty to expand either way from the centre, where only it was permanently secured from lateral motion by this centre chair. The additional expense consequent on the use of this centre chair having been objected to, it was dispensed with, and the variation of the length of the rail was afterwards provided for by a modification of the junction plate, which in the other case had been smooth, by which the end of the rail was fixed and prevented from moving longitudinally, without carrying the chair and sleeper with it, while the other end was left free to move to the extent of the space left in all cases while laying, for this particular end. This space in the depth of winter was estimated at ⅛ of an inch, and on that part of the superstructure which was laid in winter, this allowance was uniformly made at every junction, by inserting a piece of metal of the given size, and driving the rails close upon it; the laying being perfected, the slip of metal was removed. In the warm summer months, no allowance was made, and in the temperate months of autumn $\frac{1}{16}$. Fig. 7 shows the junction plate which accompanied the centre chair, fig. 6, and which presents no obstacle to the longitudinal motion of the ends of the rails. Fig. 8 is the junction plate adverted to above, and which secured permanently the one end of the rail; in this case the projections *b′ b′* instead of being placed in the centre of the chair, are on one side of it: the notches *b b* in the rail, fig. 11, fitted into these projections, and the chair being firmly secured to the sleeper, prevented the motion of the end of the rail; the other end of the rail, however, was not so secured; it rested on the side of the plate corresponding to the opposite of this plate, *c*, fig. 8, and which was therefore smooth; the rail was therefore at liberty to move (to the extent of the space left for that purpose) in that direction. In the case of this chair, the expansion and contraction, and therefore the longitudinal motion of the rail was practically about double of what it would have been with the centre chair; if the contraction amount to $\frac{1}{8}$, this contraction with the end chair was concentrated on one end; on the centre chair it was divided, occurring half at the one and half at the other; the centre in the last case partaking in some degree of the nature of a neutral point, and thus exempt from the strain which must exist in the other case. The centre chair weighed 6lbs, the corresponding junction plate 8lbs, the junction plate used without the centre chair $8\frac{1}{5}$lbs.; the prices paid for these castings were 5 and $5\frac{1}{2}$ cents per lb.

SPIKES.

There were three descriptions of spikes used as represented in figures 12, 13 and 14; *f f*, fig. 12 are different views of the same spike; there were but a few hundred pounds of this spike used on the road as an experiment; it was manufactured in England, apparently by hand, and although exhibiting more workmanship than the spikes used in this country, was offered, I think, at the same price; the head was case-hardened, and the sides ragged, so as to take a good hold of the timber into which it should be driven; these ragged points it was thought at the time would prove rather a disadvantage, from their cutting the fibres of the wood. but experience has shown it to be the most secure spike driven; it weighed probably a little over eleven ounces, for I am unable to state its precise weight. The spike of fig. 13, was manufactured by machinery, at Mr. Henry Burden's works, Troy; it was delivered in New-York at 8 cents per lb.; this spike was made from $\frac{5}{8}$ inch square bar iron, was about six inches in length, pointed and headed as shown in the sketch, and weighed $12\frac{1}{2}$ ounces. The spike of fig. 14 was made from $\frac{9}{16}$ bar iron, by Mr. William Blackington, of Attlebury, Massachusetts, it was delivered in Providence for 7 cents a pound, and weighed $9\frac{1}{2}$ ounces; it was about $5\frac{1}{2}$ inches long, pointed and headed as the last, and like it manufactured by machinery. The heads of the two last described spikes were liable to break occasionally in driving, a fault from which the first mentioned spike was free. The form of the head of these spikes will naturally suggest the mode in which it secured the rail to the sleeper: on the plates at the junction of the rails, four spikes were used; on the intermediate sleepers, three spikes were driven, two on the outside and one on the inside of the rail, as shown in fig. 3.

RAILS.

The rail used was of the same pattern as the Boston and Providence rail (an inverted T) but heavier; it weighed on an average 55·4lbs. per lineal yard. Fig. 10 shows the form of this rail: the width of the top or bearing is 2¼ inches, the depth of the rail 3½, and the width of the bottom 4 inches; the length of each rail is 15 feet. These rails cost in Liverpool (1836) £14 10*s* per ton. The other expenses attending the rails, such as the freight and primage, the harbor dues, agencies, insurance, &c. I have not been able to obtain with that accuracy which would justify my presenting them.

### MASONRY.

The masonry on the road consists of road bridges, culverts, and cattle guards—these varied in size with the exception of the distance apart of the abutments of road bridges crossing the railway, which was uniformly 28 feet. There is no rock found in site; the stones used for building purposes are procured from boulder of granite found in the hills, and which do not occur at all on the plain over which the railroad passes; these are scarce and proportionally valued; the distance which the stones required to be transported varied from 2 to 5 miles. The dry masonry of which the cattle guards were formed, cost from 3½ to 4 dollars per perch; the mortared rubble masonry of which the bridges and culverts consist, 4 to 4½ dollars.

### REMARKS.

I have purposely reserved for this place such remarks as suggest themselves with regard to the details of the work, to enable me to make the preceding description of the road more succinct and clear, as well as to avoid the confusion or annoyance consequent on introducing in that place observations partly conjectural, and therefore to many persons both inappropriate and uninteresting; I shall make no apology for noting such here.

To enable those not familiar with the peculiarities of Railroads to judge of the value of inclination independent of the controversies which agitate the public mind on the subject of locomotive engines, I would refer first to the strain, which such engines in their action communicate to the road, and which, it is very palpable, will induce a comparative estimate of the wear and tear, or of the repairs on the road and on the engine also, but at present I refer simply to the road. It will be very evident to any mind that if the rails immediately under an engine, instead of being fixed, were loose, and further, if they lie on rollers, the action of the piston and wheel of the engine, instead of creating motion in the machine, would communicate motion to the rail; the engine would remain at rest, while the rail would move from beneath it; if any force were now applied to this rail sufficient to detain it in its place, this force would obviously measure the longitudinal strain, which the action of the wheels of the engine communicates to the rail, and which strain is resisted by the sleepers, blocks, or superstructure of whatever description, which secures the rail in its place; whenever, therefore, from the imperfection of the superstructure, from the weight of the engines employed, or from their inappropriate loads, or rapidity, the rails and spikes are loosened, and the solidity of the road destroyed, the strain is very obviously greater than the strength of the particular road will warrant, the power or speed in use is obviously not in proportion to the qualities, or the properties of the road, and there must consequently exist a constant and unreasonable expenditure for repairs. It may be said that if we apply this mode of reasoning to the generality of roads, not excepting the Long Island, we should infer blame somewhere; the assertion is not less true; there are few roads in this country, at least, for we cannot assert of Europe what we do not know, on which the carriage and power employed, are adapted to the nature of the particular road. Roads, therefore, when finished, are frequently only nominally so; they may be said to be all the while making, since they are all the while requiring an unnatural and disproportioned expenditure for renewal and repair. It cannot be doubted that a better economy would arise from proportioning the engine employed, and the weight carried, always to the powers of the road; and since the strength of a road is equal throughout, the same on the level as on the ascent, a considerable portion of this power will be found due to, or lost by the inclinations existing, whatever these may be; we shall now state as succinctly as possible, and referring solely to the experience of others, what the amount of this strain may be for different inclinations.

The force of traction on a level has been estimated in England by different engineers, at from 7 to 9 lbs. per ton; it has been estimated by McKnight, on the Baltimore and Ohio Railroad, at 10 lbs; it varies on different roads, and will always be greater on a wooden road with plate rails, such as the Baltimore and Ohio, or the Paterson Railroad, than on a road with the heavy edge rail, such as the Camden and Amboy, or the Boston and Providence roads. We shall assume it here at 9 lbs., although it probably exceeds that on most of the roads in this country. If 9 lbs. then be the force required to move a ton, or a carriage of a ton weight, on a level Railroad, we have to ascertain the additional force due to any given ascent; this varies with the sine of the angle of inclination, or if the inclination be 1 in 100, the fraction $\frac{1}{100}$ will express it, and the additional resistance on an ascent of this inclination, will for one ton, be $2240 \times \frac{1}{100}$ or $\frac{2240}{100}$ or 22·4 lbs.; this value is entirely due to gravity, and is independent of the friction; the friction or resistance on a level, which was estimated at 9 lbs., must be added, giving a total of 31·4 lbs. for this inclination.

There are some considerations which would slightly increase this amount, but the above will be a sufficiently close approximation for our present purpose. The following table will present the forces required to move a ton on the different ascents of this road, as well as on higher ascents for the advantage of further comparison.*

| Inclination in feet per mile. | Length of plane per foot vertical. | Resistance of gravity in lbs. per ton. | Resist. of grav. & fric. combd., or tot. r. in lbs. per ton. | Total resistance for a load of 50 tons. | Wt. of engine req'd to move a load of 50 T |
|---|---|---|---|---|---|
| 0 | 1 m | 0 | 9 | 450 | 4 |
| 5·28 | 1 m 1000 | 2·24 | 11·24 | 562 | 5· |
| 7·92 | " 666 | 3·36 | 12·36 | 618 | 5·5 |
| 10·56 | " " 500 | 4·48 | 13·48 | 673 | 6· |
| 13·20 | " " 400 | 5·6 | 14·6 | 730 | 6·5 |
| 15·84 | " " 333 | 6·72 | 15·72 | 786 | 7· |
| 20· | " " 266 | 8·48 | 17·48 | 874 | 7·8 |
| 30· | " " 176 | 12·73 | 21·73 | 1086·5 | 9·7 |
| 40· | " " 132 | 17· | 26· | 1300· | 10·7 |
| 50· | " " 105·6 | 21·21 | 30·21 | 1510·5 | 11·6 |
| 60· | " " 88 | 25·5 | 34·5 | 1725· | 15·4 |
| 70· | " " 75·4 | 29·71 | 38·71 | 1935·5 | 17·2 |
| 80· | " " 66 | 34·24 | 43·71 | 2185·5 | 19·5 |

* This table is merely intended for the general reader; to convey to him a fair impression of the effect of inclination, without detailing the various secondary causes, which would modify the table, and also extend it so much, as probably to induce him to pass it over altogether.

The 6th column is estimated on the supposition that the adhesion is $\frac{1}{12}$ and that the weight on the driving wheels is $\frac{3}{5}$ of the whole weight of the engine; the weight on the driving wheels of any particular engine being known, its power on any of the above inclinations may be inferred; for, dividing the given weight by 12, the adhesive power will be obtained, and dividing this quotient again for any particular inclination by the corresponding amount in the 4th column, a very close approximation will be made. We perceive by this table, and the data given, will enable any one to verify it, that on a rise of 20 feet per mile, the resistance is nearly doubled, on a rise of 40, nearly tripled, on a rise of 60, nearly quadrupled, &c; we see also, that for a load of 50 tons, the adhesion necessary on a level, is 450 lbs., or the strain communicated by the driving wheels of the locomotive to each rail, would be 225 lbs.; in other words, it would require a force of 225 lbs., retaining the rail in its place to ensure the motion of the locomotive and train; on a rise of 20 feet per mile, however, there would be a total strain communicated by the driving wheels of 874 lbs., or the strains on either rail, on which these wheels respectively rested, would be 437 lbs.; or it would require a force of 437 lbs., retaining the rail in its place to ensure the motion of the train; this force is nearly double of that required for the same load on a level; the strain, therefore, is nearly doubled, and were we to proportion the strength of the superstructure to the strain, which it is required to meet, we should, on a rise of 20 feet per mile, make it twice as strong and massy as on a level; on a rise of 40 feet, thrice as strong; on a rise of 60 feet, four times as strong: on the contrary, the superstructure is of the same strength throughout. We see, therefore, how trying and deteriorating great inclinations are when compared with moderate, and having sufficiently understood what has been said, can easily understand the great repairs which heavy grades and heavy engines must necessarily ensure, while the strength of the road is not proportionally increased to meet the additional resistances. While horses were employed on railroads, this strain did not exist; the power of the horse was applied to the horse-path, or centre of the track, the weight of the carriages in that case, and the occasional lateral thrust from the wheels frequently rubbing against the rails on the straight lines, and always on the curves, were the only resistances which the superstructure had to contend with; there was no longitudinal strain on the rails, such as exists now in consequence of the use of locomotives; the resistances then were simply the direct weight, and the occasional lateral thrust spoken of.

In using locomotives, the resistance due to their peculiar action, is therefore entirely new and additional. We see then, that without reasoning particularly on this new resistance, experience has increased the strength of Railroads very greatly since the introduction of these machines; the weight of the rail has been nearly doubled; the weight and size of the bearings or blocks, has been more than doubled; the necessity of a massier and correcter superstructure has been gradually unfolded, and the road itself from being considered but a better kind of common road, is now gradually and correctly being associated with, and considered as a piece of very nice machinery, requiring in its arrangements and management, as much attention and care as the locomotive itself.

## CURVES.

The amount of resistance due to curvature on this division is not great; there is but one curve, that which occurs at the departure from the

Jamaica Railroad. The radius of this curve is 5730 feet; I am unable to say correctly what the resistance on such a curve amounts to. Mr. Knight of the Baltimore and Ohio Railroad gives the resistance on a curve of 400 feet radius, as 5lbs. per ton; on a curve of 1000 feet radius, 1lb. per ton; these statements are the results of experiments which, however, I have not seen minutely detailed; to understand the value of such experiments, we require to know the diameter of the wheels and the distance apart of the axles of the carriage, the speed, and also the difference of level of the rails on the given curve. The wheels in use on the Baltimore and Ohio road are of small diameter, compared with those on other roads; the axles are also placed closer; these arrangements are consequent on the great amount of curvature on that road; on such roads as use larger wheels with the axles further apart, the resistances on equal curvatures will obviously be much greater. The wheels used on the burthen cars of the Long Island Railroad, are 36 inches diameter, and the axles 60 inches apart; the wheels used on the Baltimore and Ohio Railroad are, I believe, 30 inches diameter, and the axles not more than 40 inches apart.

## WIDTH.

The first division of the Long Island Railroad, it has been already stated, is graduated to a width of 28 feet, and intended to accommodate two tracks. The width of the Boston and Providence Railroad is 26 ft; of the Stonington Railroad, 26 feet; of the Jamaica Railroad, 24 feet; 28 feet was adopted on the first division, because the stuff excavated being entirely composed of gravel and sand, the ditches would be more liable to fill up and choke, than when they are formed in stiffer earths, such as frequently occur on these other roads; a better reason, however, was the confessed insufficiency of the width above mentioned, and which are generally adopted, as respects the space available for the drainage of the road. To appreciate this remark, the paramount value of efficient drainage must first be understood. Among engineers this advantage is sufficiently felt; it is not, however, sufficiently acted on, because the public is unwilling to countenance the additional outlay which would be required to meet the end, on the evident belief and feeling which prevails that the amount of capital now expended on railroads is fully as much, probably more, than, considering the other important interests of the country calling for such aid, even their very great importance entitle them to. Admitting this supposition, for the present, to be true, and therefore that the public had better meet the yearly deductions from the rents of such roads consequent on the present very inefficient state of their drainage than advance the additional capital which would be necessary to obviate this evil. The question is naturally suggested whether the present mode of graduating roads for a double track, where only one will in the meantime be laid, and when one will for many years satisfy the traffic and travel, might not be changed or modified for another, which should contemplate in the first instance but one track with numerous passing places, and occupy for this one track a sufficient width to ensure an efficient drainage throughout. To enable us to understand and answer this question, we must first be able to judge correctly of what amount of business a single track can accommodate, and in judging of this, we should be justified in taking into account a more methodical and perfect system of management than generally obtains at present, and which is gradually being introduced, and will very soon be in operation, at least on some of the northern roads, such as the Boston and Lowell, &c. There is one difficulty, however, which such roads as the Boston and Providence, the Stonington, and the Long Island Railroads have to contend with, and which must either be modified so as to meet whatever system or arrangement may be introduced, or all arrangement and its advantnges must be sacrificed to this other contingency ; I allude to their connection with steamboats. The times of starting of the steamboat trains correspond at present with the arrival of the steamboats, and the time of the arrival of the steamboat is very uncertain, varying in the best weather from one to two hours ; the train is always ready to start on the arrival of the steamboat, and it seems understood and expected that no delay should occur at the landing. If the entire railroad in advance of the train is empty, and purposely kept empty, neither danger nor inconvenience can arise from pursuing this course ; but if the road is not empty, if on the contrary, it is known that a train or trains are on it, and if the time of starting (from the other end) of these trains is known, their place of meeting with the train about to start must also be known, and if that known point does not occur at a turn-out, what advantage is gained by starting exhept at the hour and minute which will insure the meeting of this train with the other at a place where provision is made for their passing. The trains move at very nearly uniform velocities, and may always be regulated so as to reach the turnouts at stated times from the hour of starting ; if, therefore, the steamboat train starts at any intermediate time, one of two things must occur: either that the trains will meet where they cannot pass, and one or other must consequently return, by which a little more time will be lost than had the delay been purposely made at the starting point ; or otherwise the engineer of the locomotive, knowing his position on the road will purposely delay, by moving at slow rates, so as to insure the proper point of meeting, and thus nothing is gained in point of time, while the contingency of meeting an extra train is increased by the increased time which the engine has purposely dissipated on the road. When the road is not empty then, there is nothing to be gained (without, indeed, sacrificing the time of the opposite train in lieu of your own) by starting, except at times corresponding with the turnouts on the road, or at times which running at the usual rates will insure their meeting only at these points. If these remarks are understood, it will also be perceived that the danger of two trains unexpectedly meeting would be greatly lessened by pursuing the other course, and by a still more systematic mode of proceeding may be all but entirely removed. When a railroad is situated inland and unconnected with steamboats, the difficulty we have spoken of will not be known, and no difficulties or objections can consequently arise from such a source. This is not the situation of the Long Island Railroad, and it must therefore, as well as all roads similarly situated, incur an additional outlay, and prepare additional conveniences to reduce this evil as much as possible, without sacrificing, on the other hand, the palpable advantages which regularity ensures, and without which no road can be either very safe or very profitable. This can only be done by increasing the available times of starting, and hence the number of passing places which would otherwise be necessary. The evil cannot, however, be entirely remedied, and there must be a loss, less or more, at the steamboat end, and corresponding with the convenience prepared.

(To be continued.)

From the National Gazette.

## *Copper for Steam Boilers.*

The tenacity of copper at ordinary temperatures, as demonstrated in the report to Congress already referred to, is on an average of nearly seventy experiments, 32 826 lbs. per square inch. The process of rolling it appears gives to this metal such a degree of uniformity, that though different specimens may be found to vary from each other as much as from 30,400 to 34,300 pounds to the square inch, or nearly twelve per cent, of the above mean, yet in the *same specimen* the greatest difference in the strength at any two points is not more than 4 8-10 per cent of its mean strength.

The trials to prove what portion of the force necessary to break any bar of copper was required to affect permanently its form, resulting in establishing about *two-thirds* of the breaking weight, as the part in question.

The *extensibility* of copper is so considerable as to allow a bar an inch wide, aad three-sixteenths of an inch thick, to be stretched from forty to forty-four per cent. of its original length without breaking—but the amount of elongation depends in a great measure on the temperature. A bar broken at 81½ degrees was elongated before giving way, thirty-four times as much as when broken, in another part, at 912 degrees.

The influence of temperature on copper is, to reduce its tenacity by every increase of heat, so that if the strength at 32 degrees Fahrenheit be known, the rise of temperature above that point marks very nearly the weakening of the copper according to the law that *the cube of the elevation of temperature is proportionate to the square of the reduction of strength.* This gives, at the temperature corresponding with ten atmospheres of pressure on the safety valve of a steam engine, (359 degrees 4.) a reduction of 12 34-100 per cent. from the strength of copper at the freezing point. At 548° 1 Fahrenheit the loss is 25 per cent.; at 851° 6 50 per cent., and at 1235 (a red heat daylight,) 88 6 10 per cent. From these data a table may be calculated, exhibiting the strength of this metal at any temperature, and in connexion with the table of pressures of steam for the same temperatures, will enable us to determine the proper thickness of metal to sustain any required force. Suppose the strength of copper to be 33,000 lbs. per square inch at 32° Fahrenheit, its tenacity in pounds. for any temperature will be found by *cubing the number or degrees of Fahrenheit above thirty-two, extracting the square root of that cube—multiplying the root by the decimal fraction* ·703563, *and substracting the product from* 33,000.

Extensive tables adapted to various pressures used in steam-boilers have been calculated on the basis of this rule, which together with the demonstration of the law, will appear in another form. They will, it is hoped, prove useful for those who would construct boilers on correct principles. By extending the table of elasticities of steam at different temperatures, published a few years since by the French Academicians, until we reach a pressure of 1000 atmospheres or 15,000 pounds on the square inch, we attain a temperature of 962° 38′, at which temperature copper would have a tenacity of only 13,033 pounds per square inch.

The research in question, therefore, now puts us in posession of the means of determining the exact degree of danger, resulting from any known temperature in a copper boiler. The fomula of the French Academicians is preferred, because it is founded on the most extensive series of observations hitherto made relative to the elasticities of steam at different temperatures, being carried, by direct experiment to twenty-four atmospheres. The inquires prosecuted in this city have extended the examinations of the relation of *tenacity* to *temperature*, even to a much higher point on the scale, than had been done for *elasticity of steam on its temperature*, by the philosophers of Paris. It will be seen, by reference to the report, that the tenacity of copper has been tried at a temperature of 1032°, at which the pressure of saturated steam would be 1353 atmospheres, or would require a safety valve to be loaded to the amount of 20,250 lbs. to the square inch; while the strength of copper at that temperature, would be only 10,755 lbs. per square inch; so that if a boiler tube of one inch internal diameter, were made an inch thick of copper, (without rivets.) it would scarcely suffice to bear the strain which steam generated within it at that temperature would exert to burst it. It has been shown that when other things are equal, the liability of boilers to burst is directly proportionate to their diameters; and accordingly a cylindrical copper boiler of *any dimensions* must, in order to have the force of pressure within, in equilibrio with the tenacities without, at the temperature of 1032° Fahrenheit, have its interior diameter, or the metal must be as thick as the diameter of the cavity within.

Copper boilers are often made of very large dimensions, and sometimes apparently without proper regard to the pressure. It has been mentioned to us that those in the Pulaski, were of uncommon magnitude, but the data are not at hand for judging whether viewed in connexion with their thickness and the pressure used, it could not be considered excessive. It must be evident that *generators*, technically so called, that is, vessels to be kept at a very high temperature, to receive, at intervals, portions of water to be at once flashed into highly elastic steam, cannot advantageously be made of this metal.

To know how much water a boiler or any part of it when heated to a high temperature can expand into steam in a given *time*, we must know the weight of metal thus heated, the temperature to which it is raised, its specific heat, and temperature of the water injected. This subject was first examined by the writer in a series of papers "on the rapid production of steam in contact with metals at a high temperature;" the experiments were commenced early in the year 1830, and the first part of the results appeared in the American Journal of Science, (vol. 19,) for October, November and December of the same year. To that and subsequent numbers of the same work, the reader is referred for the effects of iron, copper, brass, silver and gold, when thus employed at a red heat to generate steam of atmospheric pressure. It may be added, that of copper about 11 pounds heated to a dull red heat will produce from boiling one pound of steam, and will at the end of the process be found at 212°. The *time* required will vary with the amount of surface of hot metal to which the water has access. In boiler-copper one quarter of an inch thick, and presenting only one face to the water, the time will be at most *one minute and a quarter.*—The *conducting power* of this metal is greater than that of iron. This circumstance, together with the diminution of strength by the temperature, renders the danger of allowing the water to fall below the fire level, sufficiently apparent.

## *New York and Albany Railroad.*

In relation to this important work, a meeting took place at Dover, Dutchess county, on the 18th of August instant, which was attended numerously by the principal proprietors of land, and other gentlemen interested in the prosecution of the above work from the counties of Westchester, Putnam, Dutchess, Columbia, as well as others from Massachusetts and Connecticut, which was organized on the motion of Jonathan Aiken, Esq., of Pawlings, by calling to the chair pro tem., the Hon. Obadiah Titus, of Dutchess county; and Governeur Morris, Esq., of Westchester county, secretary.

The meeting having been thus temporarily organized, on motion of John M. Ketcham, Esq., of Dover, the chair appointed a retiring committee of three, to report the names of suitable persons to preside at the meeting; viz. Jonathan Aikin, of Pawlings, Dutchess county; George W. Miller, of Bedford, Westchester County; Daniel E. Baldwin, of Spencertown, Columbia county.

The committee recommended the following nomination, which was unanimously approved of;—

Joel Benton Esq., of Armenia, Dutchess county—President.

Hon. Obadiah Titus of Dutchess county; Ebenezer Foster, Esq. of Putnam county; Lewis Morris, Esq., of Westchester county; Thomas Taber, Esq., of Dutchess county; Charles F. Sedgwick Esq., of Sharon, Connecticut; Morgan Carpenter, Esq., of Dutchess county—Vice-Presidents.

Jacob Harvey, Esq, of New-York; John M. Ketcham, Esq., of Dutchess county; George W. Miller, Esq. of Westchester county—Secretaries.

Thus organized, on the motion of Charles Henry Hall of New-York the reports of the commissioner of the company, as well as of the engineers employed upon the various surveys were called for; whereupon Mr. Bloomfield, the said commissioner, responded in a very able detailed and very satifactory statement, prepared under the advisement of the executive committee of the company.

The detailed report furnished information in some measure unlooked for, and highly interesting, inasmuch as he there proved from the surveys made by the engineer, that the entire distance from Harlaem river to Albany will be less than one hundred and fifty miles; and upon a grade not exceeding thirty feet to a mile, $\frac{7}{10}$ will be level or under 20 feet; $\frac{2}{10}$ will range from 20 to 29 feet; whilst only $\frac{1}{10}$ in different places need exceed 30 feet with moderate cuttings and embankments. The report of the commissioner further stated, that he had been actively and successfully engaged in the procuring releases of lands on which to construct the road; that many large landed proprietors, situate in Westchester, Putnam, and Dutchess counties, had given releases of their property *gratis*, and in many instances the tender of *timber* for the construction of the road through their lands; at the same time, they came liberally forward and subscribed for stock of the company, in sums from one hundred to ten thousand dollars each. That the amount already subscribed in those counties, including New-York, exceeds six hundred and fifty thousand dollars, in addition to the original subscription, and the various agents on the line from the city of New-York to near Sharon, Con., had assured him (and a majority of them confirmed that assurance at this meeting) that in their opinion more than a million of dollars would be forthwith obtained.

The commissioner also exhibited a very satisfactory statement collected from gentlemen residing in the various counties through which the road will pass, as well as in the states of Massachusetts, and Connecticut taken from actual statistical data, which proved to demonstration that the receipts for the carriage of passengers, agricultural and manufacturing products, as well as of merchandize generally, will make a return thirty per cent. in gross, upon the probable amount of capital that may be invested in the putting the road into successful operation: and this without any *prospective* speculation upon the natural increase of population, agriculture, manufactures and trade.

The reports of the engineers, Mr. Morgan and Mr. Shipman, were much to the satisfaction of the meeting, and showed conclusively, that the New-York and Albany railroad can be constructed not only upon a most favorable grade, but at an expense far less than any railroad which has hitherto been laid down within this state. The following extract may serve to show the opinion of the engineer. "There is no railroad east of the Allegany mountains of equal extent that can be compared with the one in question, in point of mechanical advantages: and it is a very remarkable circumstance that in so long a line the rock cutting is so comparatively trifling."

The engineers presented to the meeting, maps and profiles of the entire route from Harlaem river to Greenbush, opposite Albany, (also of a line through Sharon and Salisbury into Massachusetts,) which served to prove the accuracy of their reports to the commissioner, and the executive committee.

The reports having terminated, the meeting was addressed by a number of gentlemen in a most eloquent and effective manner, showing throughout an entire conviction of their belief in the feasibility of constructing the road, and the facility of procuring the means of doing so.

Mr. Charles Henry Hall, the president of the company, being called upon, then addressed the meeting in a very animated and decided manner, setting forth the advantages of the road, the necessity of the entire co-operation of the counties through which it might pass, not only of the gratuitous furnishing of land, but in the subscribing of money; and clearly demonstrated the practicability of making the road and finishing it within a short period of time.

That among the advantages that would be derived from the construction of the road in question, would be the junction that would be formed with the 'Great Western Railroad' from Boston to Albany, via the Housatonic Valley, as also direct to, and with the Railroads from the west, terminating at Albany and Troy. At the same time, a union that may be made with the Danbury Railroad at the Connecticut line, also that of the Canajoharie Railroad, terminating at Catskill; which would naturally, and of necessity, form a continuous line of road from the west and southern tier of counties with that road, with branches terminating at Newburgh and Kingston. Mr. Hall adverted to the advantage that would arise in the carrying of the various mails, which would prove a source of great revenue to the company.

The Hon. N. P. Tallmadge, of Poughkeepsie, requested Mr. John M. Ketcham to state to the meeting his regret at not being able to unite in its deliberations, and at the same time to state his entire conviction of the propriety as well as the necessity of prosecuting the work in question, in order to throw open and perfect the communications by means of Railroads throughout the state. That at the date of the New-York and Albany Rail Co. charter he had advocated it in the senate of this state, and since had no cause to change his opinion, being satisfied that all sectional jealousies should be acted on promptly and with unceasing industry and perseverance.

Jacob Harvey, Esq., of New-York, also addressed the meeting. He expressed his surprise, and gratification, at meeting so *large* an assembly, one far larger than that which first convened in New-York, in reference to the Erie Canal. He was particularly pleased to see so many farmers present, so much of the agricultural interest, the bone and sinew of the state, engaged in a work for the especial benefit of the *city*, which was tributary to the *country*: the agricultural leading the commercial interest. He was willing to place the city in the *second rank*.

He hoped there would be no discouragement, nor did he believe there would be, if gentlemen would remember the inauspicious commencement of the Erie Canal, which was pronounced a visionary and *impracticable project*, and to such an extent was hostility carried, that De Witt Clinton lost the vote of Herkimer county, because it was said that he had ruined many of the finest farms of that county by cutting a '*big ditch*' through them. He assured gentlemen that while he believed there should always be a *quid pro quo*, and that people could not be expected to give their land without an equivalent, yet that as in the case of the ruined farms of Herkimer county, the farmers could not, at this time, be induced to have the big ditch filled up; so, gentlemen by giving their lands to the New-York and Albany Railroad Company, would find that they would receive *more* than they *gave*, that there would be a large balance of benefits in their favor. After many other sensible and practical remarks, Mr. H. concluded by offering the following resolutions:

1st. Resolved, That this meeting view with great satisfaction the enterprising spirit which successfully pervades our sister states, Connecticut and Massachusetts, on the subject of railroads and their attendant advantages, and that we hail with pleasure the approaching connection of the Massachusetts 'Great Western Railroad,' with a connecting line from New-York to Albany.

2d. Resolved, That we congratulate the citizens of this state, and of its southern section particularly, on the manifestation of increasing interest in railroads, which is daily giving earnest of a determination to unite in a system of inter communication, so auspiciously commenced in the north; —by which the resources of this state may be fully developed; proportioned to the enterprise of her citizens, and on a scale commensurate with their intelligence and wealth.

Charles F. Sedgewick, Esq. of Sharon, Connecticut, after prefatory remarks of the vast importance it would be to this section of the country to unite in a junction of railroad from thence to the line of the New-York and Albany Railroad, said, that he had observed in one of the resolutions a complimental notice of the states of Massachusetts and Connecticut in reference to their zeal, in relation to railroads. He was not acquainted with any gentleman present from Massachusetts: but, he expressed the thanks of himself and his associate, Col. King, in behalf of Connecticut, for the kind expression of the resolution which had been adopted, and he assured the meeting that those in whose behalf they appeared were zealous in directing their personal and persevering efforts in support of the great cause which they wished to see advanced. Mr. Sedgewick terminated by an eloquent and forcible appeal, which made a strong impression upon the audience.

Thomas Taber, Esq , of Dutchess county, after addressing the meeting, and alluding particularly to the necessity and importance of the farmers generally, ceding their land gratuitously, offered the following resolution.

Resolved, That the thanks of this meeting be given to the agents of the company, for the attention which they have heretofore given in procuring subscriptions and releases, and that they be requested to continue their exertions with as little delay as possible.

The Hon. Obadiah Titus, of Dutchess county, offered the following resolutions ;

Resolved, That this meeting have the most entire confidence in the practicability of constructing the New-York and Albany railroad, and are fully sensible that the most important benfits will result from its construction.

That we have the fullest confidence in the integrity and ability of the gentlemen engaged as officers and agents in the management of said road.

On motion of Joseph D. Hunt, Esq., of Amenia, it was

Resolved, That the publishers of newspapers in the cities of New-York and Albany, and in the counties of Westchester, Putnam, Dutchess, Columbia and Rensselaer, be respectfully solicited to publish the proceedings of this meeting.

An amendment to this resolution was then submitted and carried, by Col. King, of Sharon, Connecticut, adding a request of the same import, that the Massachusetts and Connecticut newspapers be solicited also to publish the proceedings of the meeting. Adjourned.

*Dover, August* 18, 1838.

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## *Internal Improvement.*

Recurring to this subject, as we promised, we proceed to offer such suggestions as may aid in establishing a plan for extending the aid of the state to the Railroads now in progress. We have expressed the opinion (and we believe no one will doubt its correctness) that the state road will prove of little use if it stops at the Chattahoochie ; we have further said it would be proper to carry out the views of the Macon Convention. Let us look at the prospect and probable cost of three lines of transportation from the end of the state road in De Kalb, one to Augusta, another to Forsyth, and a third towards West Point and Columbus.

The Georgia Co. has already finished its road a distance of seventy miles from Augusta, and within a year will be at Madison ; it has expended over one million of dollars on its road, and must necessarily pay further large sums in carrying on its roads to Madison and Athens, and the other points contemplated by its charter. This company has a present capital of two millions, devisable between its bank and road, all of which has been paid in. With this capital it can probably complete the road to Madison, about ninety-five miles from Augusta. It has the right of extending the road from Madison to the state road, a distance of about 65 miles. It is quite certain, we think. that it cannot without an increase of its capital, extend its road beyond Madison, to say nothing of its other branches, and we fear that without the aid of the state, even with an allowed increase of capital, it cannot unite with the state road by the time of the completion of the latter.

The Monroe company has graded its road from Macon to Forsyth, has nearly finished laying the superstructure, and will within the present year, run locomotives between those places. This road is about twenty-five miles long, and will cost over $300,000. (We desire it to be understood that we do not pretend to be exact in distances; outlay of money, or cost of road of the companies which we notice, but we design to be near enough the fact for present purposes.) The capital of this company is $600,000, with liberty to increase it to twelve hundred thousand dollars, for the purpose of extending the road from Forsyth to the state road. The new stock is now advertised, and it will soon be determined how far the funds of individuals will be applied to the work. We earnestly hope that the subscriptions will be ample, but apprehend that the profits hitherto made in agriculture and merchandising, and the novelty, as yet, of the enterprise will, prevent capitalists from embarking to the desired extent. In connexion with this road, our own, the Central Railroad from Savannah to Macon, must now claim attention. The Central Company has, by charter, a capital of three millions, which it may divide between its road and bank,—more than one half cannot be used in banking, though all may be applied to the road, and, by the terms of the charter, the road must be finished by December, 1843. Only two millions of the capital have been subscribed, sixty-seven and a half per cent. of which has been called in, and that amount has been applied, $27 50 to banking, and $40 00 to road. The road is under contract for 100 miles—graded near 80 miles—finished about 40—and iron for 82 miles is paid for. Three locomotives with freight and passenger cars are in use, and other materials have been extensively provided. We understand that the expenditures including depots, right of way, and property for the road, amount to about $730,000. The contemplated cost of the road to Macon is about two millions. With the present capital subscribed, this company may, diverting the bank capital, build the road with the residue of the capital paid in, it may build the road and have a bank of about one million. The subscription of the remaining stock would ensure the building of the road by the 1st day of January, 1842, and, probably at an earlier day. But at present, it is impossible to procure from individuals a further subscription of one million, especially as by the charter (a most impolitic provision as we conceive) no foreigner can subscribe for stock. This company, then requires the aid of the state to enable it to finish its road by the time of the completion of the state road. The Monroe Company will require like assistance, for it will require about one million of dollars to carry its road to DeKalb.

The company, chartered with a capital of two millions to construct the other line from Columbus to the state road, has been duly organised and is about to commence the necessary surveys. We are not sufficiently acquainted with the country to say how great will be the length or what the cost of this line. We suppose the distance to be about 100 miles and the cost about one million

We see, then, that about four millions of dollars would ensure the speedy completion of the three roads referred to in the commencement of our remarks. We think a less sum would accomplish the object. The immediate consequence of the completion of these roads would be to give large profits to the state road, and an overflowing public treasury. But it is not necessary that the state should actually expend one dollar of the amount. Let the state lend to the Georgia and Central Companies, each, $750,000—and the whole contemplated work can be acomplished in the course of the next three years. Will the state be safe in making such a loan? Where is the security against loss? To these important enquiries we answer, that money or credit was never loaned upon safer security than can be given. The *roads*, (we say nothing of other property, the amount of which will be great) of these companies will be worth at least six milions of dollars—they can be mortgaged to the state, with liberty to foreclose, if the principal and interest be not punctually paid as agreed on, or if even the interest be not paid liberty may be given to foreclose for the whole sum loaned. If by any casualty it should become necessary to foreclose the mortgages, and for the state to become the owner of the roads, the public will have the state work extended from De Kalb county to the cities of Savannah, Augusta and Columbus—for the comparatively small sum of three and a half millions of dollars. Does any rational man suppose, that with such a pledge given, any of these companies would fail to comply with the condition of the loan.

We respectfully ask public attention to this plan, for we see the great importance of having these three lines of road all finished by the day of the opening of the state road. One year's delay in the forging of any link of the great chain will be disastrous. We have rivals for the great prize of the western trade, and should neither slumber nor sleep. We shall be willing to yield our plan to any other which will speedily accomplish the great end in view. We will give our feeble aid, at all times, to make Georgia what she ought to be and what she can do —with little hazard, and simply by giving encouragement to individual enterprize—*the outlet of the great west.*

We have, in the preceding remarks, not mentioned the line of road from De Kalb to *Milledgeville*, not because we are unwilling to see that embraced in the general plan. We cordially agree, if the citizens of Baldwin and the other counties interested shall desire it, that the last mentioned road shall also be embraced. for, in truth, we were of opinion when the act was passed to build the State road, that provision should have been made for extending it to the seat of government at the expense of the State. We should be proud to see the State road so extended either by the public treasure or by individual enterprise.—*Georgian.*

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## *Embankments from the Sea.*

There seems to be no operation connected with agriculture which promises more immediate and important results than the reclaiming of submerged lands in the estuaries in our large rivers. Till within these thirty years, the sole object contemplated in embanking submerged grounds, seems to have been the exclusion of water from the surface of soil which required only to be protected from its occasional invasions, and kept dry merely to make it eminently fit for most productive cultivation. Within the last twenty years, a system has been entered on, and is now, in the Forth and Tay in particular, being carried out to the most astonishing extent, not only of bringing into a cultivable state lands already, but for the periodical submergence, fit for cultivation, but of causing rivers to precipitate their mud in convenient localities, and so of creating fields where nothing before existed but a gravelly river bed, covered by from eight to twelve feet of water every tide, of the most unprecedented and unlooked for productiveness.

In the Forth, 350 acres of this sort of land have been, in the last twelve years, reclaimed by Lady Keith, at a cost of about £21,000, and affording an annual return of about £1,400, or nearly seven per cent. In the Tay, seventy acres have been recovered opposite to the shores of Pitfour, 150 on those of Errol, and twenty around Mugdrum Island, making in all 240 acres, at about an outlay of £7,200, yielding an annual rent of about £1,680, or upwards of twenty-three per cent. On the Errol estate alone, 400 acres are just about to be embanked, in addition to the above 150, all of which may probably be in cultivation before 1847. Off the shores of Sea-side, a wall just now being built, 800 yards in length, will effect the recovery of not less than 150 acres; and on Murie property, 50 acres might be taken in by seed-time 1838. The operations of the embanker, which began off Pitfour, 1826, will thus probably have been brought into cultivation before 1846, on a shore of not more than seven miles in length, no less than 810 acres of land, renting at from £6 to £7 per acre, or of a gross annual value of £5 670, and a gross total value, at twenty-five years' purchase, of £141,750. This is a clear creation of £117,450 of new agricultural capital, taking the reclaiming cost at £30 an acre. The junction of Mugdrum Island to the north shore would probably afford 1000 acres at a single operation, while thrice that surface might be obtained betwixt Errol and Invergowrie.

The capabilities of the Forth, over and above what has already been effected above and below Kincardine, are not much, if at all, behind those of the Tay, though no sufficient inquiry has been made to permit details to be gone into.

The basin of Montrose affords a surface of nearly 3000 acres, all capable of embankment, and which, by being relieved of the salt water of the ocean, which every tide at present overflows them and keeps them submerged for twelve hours out of every twenty-four, and irrigated by the fertilizing current of the Esk, which, for at least forty days every season, bears along with it not less than 1,800th part of its weight of the richest mud, might speedily be made not less productive than those of the Forth or Tay.

It is probable that between North Brunswick and Montrose are to be found the most favourable localities for embanking on the east coast of Scotland, if not indeed the only ones which could be made available with a sure prospect of profit. It would be at the same time well that the debouches of all our great rivers were examined, lest at the mouth of the Sprey, the Dee, the Don, the Esk, and the Tweed, might lurk localities equally accessible to the embanker, and equally unlooked-for, more than in the Tay or Forth thirty years since.

If the harbours on both sides of the Forth be examined, as low down as Dunbar on the one side, and Crail on the other; and those on the Tay down to Broughty Ferry; on the Esk to Montrose and Ferryden, larger quantities of silt will be found accumulating in each of them, quite as impalpable and fine, and probably, if freed of salt, as fertile as those deposited and taken in higher up the rivers. It is probable, then, that lands might be embanked much farther out in the estuaries than seems at present to be suspected, by much the greater part of the argilaceous flocculi which the river bears along with it being actually carried out to sea.

The various embankments hitherto completed have been constructed by those manifestly little acquainted with hydraulic engineering, with little concert amongst the proprietors, and without almost any recognition of general principles or systematic plan of procedure. Many anomalies are consequently apparent in the now finished works, and many cases of useless expense and annoying inconvenience have arisen which it would have been most desirable and not difficult to have avoided.

On these and on many other grounds which must be apparent, but to enter into a detail of which would be much too tedious for the present memoranda, it seems most important that something should be done in the way of an historical account of all the embanking operations of any importance in Scotland, whether for the purpose of merely defending lands previously existing, but liable to periodical inundations, from tides or river freshes, or for the purpose of obtaining and enclosing accumulations of silt, which, but for the skill and industry of man, would have been wholly swept away.—*The Quar. Journal of Agriculture, Scotland.*

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### *Wetumpka and Coosa (Ala.) Railroad.*

We give the annexed extract from a letter, dated "Encampment, 25 miles N. W. of Wetumpka, Ala., August 24th," in order to keep our northern readers apprised of the progress of Internal Improvement in the Southern States—and with the hope that it may tend to urge on similar works in other sections of the country.

We take the present opportunity of renewing our request to Engineers to furnish us, at an early date, with a particular description, and complete statistical account of works now under their charge; but more especially of those which are completed, and now in use. They will find the commencement of a series in the present number—the Long Island Railroad, which is to be also published in a pamphlet, with lithographed illustrations, and will be for sale at this Office and at the Book-Stores.

We hope to follow it with a description of every Railroad in the Union; and if we succeed in obtaining them from authentic sources, we hope to be able to publish them all in a volume separate from the Journal; our success in the undertaking will depend, however, upon the prompt and kind attention of Engineers, and Gentlemen having the means, to our call for the individual descriptions.

☞ As a further inducement than a desire to have an account of many works of the kind included in such a publication, we will offer to each gentleman furnishing a proper and full account of any work which he may have completed, or may now be engaged upon and near its completion, a copy of the book when it shall be published.

"I had intended to draw up some brief account of the progress, prospects and general advantages to our State and the South, of this work (the Wetumpka aud Coosa Railroad), but in consequence of a constant press upon my time, I am unable to do so at present. At some future day it may be convenient for me to fulfil my wishes in this respect. I will say, however, *en passant*, the graduation is progressing with as much rapidity as the circumstances of the times will permit. The timber for superstructure upon some five or six miles is upon the line—and the location is now going on at this point, with the expectation of a speedy increase of force. The country through which the route lies is remarkably healthy—abounding in the best of timber, immediately contiguous to the line—and doubtless the stock will be very profitable."

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*Iron Steamboat on a new plan.*—Mr. Ogden, American consul at, Liverpool, writes to Mr. Caldwell, New Orleans, thus:

I had an opportunity, when Capt. Glover's ship, the Star, was in the graving dock, to take her measurements outside and in, the result of which was, the perfect conviction, on which I would stake my life, that with the engine I am putting on board my small boat, the weight of which with the boiler, water, and all complete, will not exceed from 10 to 12 tons, I can drive that ship upwards of six miles an hour, with a consumption of from two to three tons per day. The space occupied to be the after hold from the mizen-mast, not interfering in the least with her cabin or between decks, except where its chimney comes through, immediately forward of the mizen-mast. The two small roofs aft to communicate with the engine room, giving it the benefit of the two quarter cabin windows, and to be used for the berths of the engineers, &c. The wheels are through each quarter, will be six feet in diameter, and may be thrown in and out of gear at pleasure, so as not to impede the way of the ship when the engine is not in use.

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*Mexican Gulf Railrord.*—An attempt is making to proceed with the enterprise of a railroad from New Orleans to the Gulf of Mexico. The company was chartered a year ago, and last March the state granted it a loan of $100 000, provided satisfactory security could be furnished. Books are now opened for the subscriptions. This road will pass through Bons Enfans street, thence following the Mississippi and the Terre aux Bœufs, as far as Lake Borgne, where a harbor will be established, and the main branch will traverse the point of land between the river and Lake Borgne, and strike the Gulf of Mexico, opposite Cat Island, where, by recent soundings, sixteen feet water have been found.

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"During the first week after opening the London and Southamton railway, upwards of 5000 persons travelled by it; and during the second week the passengers exceeded 10,000, owing to the Epsom races. The regular and steady traffic on the road, referable to the part already opened, considerably exceeds the estimate formed by the Directors.—*Chronicle, London, June* 9.

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*An Important Invention.*—Mr. Amory Amsden, one of our most respectable citizens, has shown us an invention for ascertaining the weight of the lading of canal boats, without removing the boat from the water, which it strikes us, will be of almost incalculable importance to the country. The apparatus is very simple, and can be constructed for a small amount of money.

We do not know that we can give an intelligible description of it, but we may possibly give the reader some idea of its operation. A hole is to be made through the bottom of the boat, in the centre, through which a tube is inserted that goes down into the water. Through that tube passes a spindle with a buoy at the lower end. The buoy of course floats upon the top of the water that runs into the tube. The upper part of the spindle is marked and figured similar to steel yards. When freight is put on the boat, it sinks deeper into the water, and more water runs into the tube, which raises the spindle. For instance, while an empty boat is lying in the water, put 1000 pounds upon it, the boat sinks and the spindle rises to the 1000 pound mark.

If this invention prove successful, it will certainly be important, and ensure to Mr. Amsden both fortune and reputation. It will supersede the necessity of weigh locks, which are a vastly important item in the expensive construction of canals. We understand some of the weighlocks on the Erie canal cost the State $40,000. A large annual expense is also necessary to keep them in repair.

Again in the preservation of boats, it will be of great utility. We are told that they are injured more by weighing than in any other way. Some say our boats would last double the time they now do, if their weight should be ascertained without taking them into a weighlock.

Those who have seen Mr. Amsden try experiments of weighing, give it as their opinion that his invention will prove successful.

We think it would be well for our Canal Commissioners to examine its merits, before they go to the expense of constructing weighlocks for the enlarged canal.—*Rochester D. Adv.*

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☞ The following lettter, charged with 18¾ cents postage, is only a common mode of subjecting publishers to expenses which are unjust, ungenerous, and extremely perplexing. We make it a rule to change the direction of the Journal always, and to supply missing numbers cheerfully, if we have them, when requested; but to be required to *pay postage* in addition, has very little tendency to promote that equanimity of temper so necessary in warm weather.—*Eds. R. R. J. & M. M.*

"*Editors American Railroad Journal:*—Please to direct the Journal to ——— at Port Jackson, Montgomery Co. N. Y., instead of this place."

*Fultonville, N. Y. September 1st. 1838.*

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☞ The question is frequently asked—"Can a full set of the Railroad Journal, from January 1, 1832, be obtained—and if so, at what price?" In reply, we say, that a few sets more can be furnished by *reprinting* three numbers of Vol. *four*, for 1835, which were destroyed by fire.

We can furnish *three* complete sets, of six volumes each, at this time, at $25 the set, half bound, and will send them, carefully packed, to order,

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*New-York and Albany Railroad.*—In correcting the addition of the income on this important avenue into the interior, from $850,000 to $990,000, the sum it should be, we inadvertently changed the revenue to be derived from the transportation of Cattle, from $40,000 to $400,000. We, however, repeat our former opinion—"that *any* estimate, upon the present data, will be more than realized when completed in 1842.

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☞ For Jarvis please read Jervis, at the close of the Water Commissioners' Report in our last number.

AMERICAN

# RAILROAD JOURNAL,

AND

# MECHANICS' MAGAZINE.

No. 7, Vol. I.] New Series.] OCTOBER 1, 1838. [Whole No. 319. [Vol. VII.

On our return from a tour of observation, we beg leave to return our most hearty thanks to our friends generally, for their kind attentions; but we would be wanting in courtesy, not to acknowledge particularly our indebtedness in several instances.

By the politeness of the proprietors, or those connected with them, we were enabled to examine, with much satisfaction, the Locomotive Manufactories of Mr. William Norris, Mr. R. Campbell, and of Mr. M. W. Baldwin.

To Mr. Hassinger, President of the Philadelphia, Norristown and Germantown Railroad Company—To Mr. Joseph S. Kite, Superintendant—and Mr. John Cash, Superintendant of Locomotives, we are indebted for repeated opportunities of passing over their road, and examining the machinery, &c. connected therewith.

From Mr. Peter Wager, President of the Norristown and Valley Railroad Company, we likewise have received information concerning the prospects and advancement of this work.

A very gratifying visit to the Philadelphia and Reading Railroad, was afforded by the politeness of Mr. Wirt Robinson, Chief Engineer, who accompanied us in our visit; from him and Mr. M. Robinson, Consulting Engineer, we received very ample information, and also several maps and reports. Mr. G. A. Nicholls, Resident Engineer, conducted us over the depot and extensive grounds connected with the Company's works at Reading. We are also indebted to him for the promise of particular information concerning this fine road.

To Mr. R. Wording, President of the Lancaster and Harrisburg Road, we are indebted for reports; and to the Messrs. Rallstons for several polite attentions.

From Matthew Newkirch, Esq., President of the Baltimore and Wilmington Railroad Company, we are indebted for much information, opportunity of examining the road, and also for several reports. Mr. S. Kneass, Engineer, also kindly promised us a particular description of the road.

We were much pleased with a visit to the extensive Car Manufactory of Messrs. Betts, Pusey and Hanlan, at Wilmington; where we also collected some information in regard to the improvement in cars, &c.

From John Randall, Esq., C. E., we received information concerning several works.

To Mr. B. Latrobe, of the Baltimore and Ohio Railroad, who furnished reports, maps, &c.; and to Mr. Henry Kreles, we are indebted for an inspection of sundry maps, profiles, and also for the opportunity of passing over the Baltimore and Ohio Railroad.

From Isaac Trimble, C. E.; M. G. Winchester, and other gentlemen, directors, &c. of the Baltimore and Susquehanna Railroad Company, we received many polite attentions, and an excellent opportunity of examining so creditable a work.

For drawings and explanations in regard to the Locomotives used on the Baltimore and Ohio Railroad, we are indebted to Mr. R. Winans.

To them, and others who have tendered their polite attentions, we beg leave to return our warmest acknowledgments, wlth a promise to use the information so acquired for the greatest possible benefit of all concerned in the cause of internal improvements.

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## *Kite's Patent Safety Beam.*

Among the many improvements in regard to Railroads, presented to our notice during our recent tour, but few have greater claims to perfect simplicity and entire efficacy, than the Safety Beam of Mr. Joseph S. Kite, Superintendant of the Philadelphia and Norristown Railroad.

On the Southern Roads, no accident appears to be dreaded by travellers so much as a breaking of the axle. The fear on this score seems to have originated in several fatal accidents, particularly with the four wheel cars. The invention of Mr. Kite is calculated not only to prevent any danger from such breakage, but we think, also, to prevent such breakage in many instances.

We had an unexpected opportunity of witnessing its efficacy as a *Safety* Beam. From some cause unknown to us, a wheel of an eight wheel car had cracked and broke to pieces, while under way. The front truck was thrown off the track, but most fortunately the axle remained entire, and this we attribute entirely to the fact that the sudden strain was received upon the boxes in the Safety Beam, and any further fracture prevented.

Had the axle been broken, the car must have been dashed entirely off the track, and the passengers seriously injured. As it was, there was not the slightest injury done to any one, and the car was not even scratched, and in nowise hurt save in the wheel.

It has been objected to the use of these and other preventives, that it matters not whether they are applied or not, for the people do not ask the question—" Has this car Safety Beams ?" before they enter it. We are pleased in being able to say that the public *are* enlightened on this subject, and *do* ask such questions—and so well convinced are companies of this fact, that we find nearly every where the words " *Safety Beam*," written on the cars ; and in all instances where the trucks are marked as having Kite's Patent Safety Beam, we can assure our readers that the cars *are* patronized in preference to any other.

The general use of this simple preventive of accidents is a sure test of its excellence, and if *one* life has already been saved by its use—we consider the community benefitted to more than ten times the amount of its small cost.

We subjoin testimonials highly commendatory of Mr. Kite's invention, which we think cannot be too generally praised and carried into use.

In our next number, we intend making some remarks upon the use of eight-wheel cars.

*To the Public.*—In consequence of the late lamentable accident upon the Columbia and Philadelphia Railway, (caused by the breaking of an axle of one of the cars,) the subscriber is again induced to call the attention of the public to his improvement, by which such accidents can be effectually guarded against.

To enable the public to judge of the utility of the invention, he respectfully submits the opinions of gentlemen who have examined its principles.

Jos. S. Kite, Patentee.

☞ Patent Rights will be disposed of upon very moderate terms, upon application to the Patentee.

Philadelphia, October 6, 1886.

*Patent Safety Beams for Railroad Cars.*—The subscriber has obtained Letters Patent of the United States, for an improvement in the construction of Railroad Cars, in which, by the application of what he calls *safety beams*, the injurious effects resulting from the breaking of the axles of the wheels are entirely obviated, as the car will be sustained by them, and may even travel to a considerable distance after such accident has taken place.

These safety bars add but little to the weight of the car, and do not increase the friction in the slightest degree, and their efficiency will be apparent to any one in the least degree acquainted with the nature of such vehicles; upon this point it is confidently believed that there can be but one opinion.

Persons desirous of ascertaining the nature of this improvement, or of obtaining rights to use it, may do so by applying to the Patentee.

JOSEPH S. KITE,
Superintendent for the Philadelphia and Norristown Railroad Company,
corner of Ninth and Green streets, Philadelphia.

The Committee on Sciences and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was submitted by Mr. Jos. S. Kite, of Philadelphia, his improvement on Railroad Cars.

## REPORT.

That it is well known that the fracture of such axles almost invariably takes place near the nave, or hubb, of the wheel, and the desideratum in such a case, is to preserve the two pieces of axle from *falling to the ground;* and consequently overturning the car. This Mr. Kite proposes to effect by introducing in each car two longitudinal pieces of timber, which he calls *safety beams*, inside of the wheels, and parallel to the usual string pieces which support the boxes or chairs of the axles.—To these inside beams are attached an additional set of chairs, which, in order to avoid unnecessary friction, are so arranged as not to come into contact with the axle, except when the latter breaks. When this happens, they arrest the descent of the wheels; and thus not only retain the car in an upright position, but may even permit it, in some cases, to proceed as before. These chairs are so constructed, with double bearings, as to allow play to two axles of different diameters; the smaller bearing being for the axle proper, and the larger one for the *nave of the wheel;* which, if the break takes place immediately at the union of the hubb and axle, becomes itself a temporary axle upon which its attached wheel revolves independently of the axle proper; the latter with its wheel being supported by the smaller bearing of the double chair. The wheels are prevented from separating transversely by means of proper keepers, outside of the chairs. The committee consider Mr. Kite's arrangement both effective and simple, and consequently recommend it as deserving of practical test.

Copied by order of the Committee.

WM. HAMILTON, Actuary.

Hall of the Franklin Institute, Philadelphia, June 12, 1834.

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Philadelphia, August 30, 1834.

To Joseph S. Kite:

Sir,—I take pleasure in stating that I consider the 'Safety Beam' introduced into Railroad Cars by you, a most important and valuable improvement. It affords ample security to passengers, in case of an accidental fracture of the axle, (such as occurred on the Camden and Amboy Railroad, some time since) and adds, at the same time, but little additional weight and expense to the car. The great utility of the improvement is only apparent to the public, when it is known that all similar disasters may be avoided by its adoption in Railroad cars in general. I have reason to believe the plan will succeed, and be generally adopted. I am, very respectfully, your friend,

HENRY R. CAMPBELL, Engineer.

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Lancaster, May 6th, 1836.

Joseph S. Kite, Esq.

Dear Sir—I have examined your improved Safety Beam for railway cars, and take great pleasure in expressing my opinion, that the improvement is a valuable one, and admirably adapted to the purpose for which it was designed, viz.—the saving of lives and property.

The simplicity and economy of its arrangement, as well as the unusual degree of security which it affords both to cars and their freight, are such as affords strong recommendations for its immediate introduction into general use, particularly on railways, where steam is used as a motive power.

I shall be happy to aid you, or to hear of your success, in extending the use of an improvement so desirable. Yours, very respectfully,

EDWARD F. GAY,
Principal Engineer Columbia and Philadelphia Railway.

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Newcastle, March 23d, 1835.

Mr. Joseph S. Kite:

Dear Sir,—After a close investigation of the principles and arrangement of your Patent Safety Beams for railroad carriages, &c. I feel no hesitation in recommending them to the attention of all companies or persons interested in the transportation of passengers or goods on railways, being by far the most simple, economical, and safe contrivance, in my opinion, which has yet come under my notice.

With great respect, yours, &c.
EDWARD G. YOUNG,
Engineer in Chief, N. C. and F. T. R. R.

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I fully concur in the above recommendation of your Patent Safety Beams for railroad carriages, T. STOCKTON,
Superintending Director of N. C. and F. T. R. R.

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Joseph S. Kite, Esq.:

Dear Sir,—I have examined your improvement of Safety Beams for railway cars, and take pleasure in saying, I believe it to be a valuable one, which if generally adopted, would materially lessen the liability to accident, and consequent destruction of property. It needs only an inspection to satisfy the most sceptical of its great utility.

Very respectfully, yours, JOHN S. CASH,
Late Sup. Motive Power, Columbia and Philadelphia R. R.
Philadelphia, September 30th, 1836.

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New-York, 1st May, 1836.

Joseph S. Kite, Esq., Philadelphia.

Dear Sir—From the examination of the model of Wheels and Axles for a railroad car that you showed me when in Philadelphia, I consider the invention of much public utility, and have not the least doubt but that the plan which you have adopted, will be the means of preventing those serious accidents from the breaking of the axles of railroad cars.

I am, dear sir, yours, ADAM HALL,
Engineer in Chief of the West Point Foundry, New-York.

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Having examined the invention of Jos. S. Kite's Safety Beams for railroad cars, and seen its practical utility tested by numerous experiments, I have no hesitation in recommending it to all companies and individuals concerned in the building of cars, as the best security against railroad accidents, that has been offered to the public. The value of this improvement, affecting the security of the thousands of passengers daily conveyed on Railroads, throughout the United States is so great, and the expense of its introduction so trifling, that we may reasonably hope to see it speedily and universally adopted. WM. LEWIS, Engineer.

Philadelphia, November 8, 1834.

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*Instruction in Civil Engineering—Literary and Scientific Course of Columbia College.*

We have been repeatedly asked where a complete course of preparatory instruction for those intending this profession might be obtained; we have only to refer those desiring such instruction, to the advertisement on our cover. The advantages offered by this course are greater than can elsewhere be obtained in this country.

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*Genesee Valley Canal.*

OUR readers will perceive by the advertisement on the cover, that a large portion of this work is about to be placed under contract. The following letter from the Chief Engineer, explains certain changes in the estimates, which we are glad to find are based upon the superior character of the construction. A permanent and durable work is greatly to be desired, when the importance of the work is as great as in this instance.

*Cuba, September 24th,* 1838.

To the Editors of the Railroad Journal.

GENTLEMEN,—You will see by this notice that a large portion of the Genesee Valley Canal is about to be put under contract.

This letting embraces all the work on the line not contracted for, excepting about 18 or 20 miles at the southern extremity, and will probably cost some $2,500,000.

The estimate of the whole cost of this Canal, upon the present plan, is not yet completed, but will range somewhere between four and five millions. The estimate of 1834 for this work was about $2,000,000. This difference in cost is owing to a change in the character of the work. The estimates of 1834 were based upon plans of a temporary character—Locks of wood, with dry walls, &c. The present plans are for work of the most substantial and permanent character, and so far as the work has progressed, I presume I shall be correct in saying, that, in point of durability, it is not surpassed by any similar work in this State; except it may be by some of the new works now being constructed on the Erie Canal.

In connexion with the proposed improvements in the navigation of the Allegany River, this work has been gradually growing in importance with the public; and hence the necessity and importance of permanency in its construction. Very respectfully, yours, &c.

FRED. C. MILLS.

## *Atlantic Steam Navigation.*

Our readers will be pleased to learn of the safe arrival of the "*Great Western*," after a voyage of only 16 days, with much tempestuous and adverse weather.

The following extract from the N. Y. American gives several interesting particulars under this head.

"The arrival of the steam packet Great Western, Lieut. Hoskin, puts us in possession of intelligence to the 8th inst, from Bristol, which port she left at half past five that evening, and from London to the evening of the day previous. The great success of this enterprize has confirmed the timid and almost crazed the sanguine.

"She brings *one hundred and forty cabin passengers.* All her berths were engaged before her arrival at Bristol. The London Times says:— 'So numerous were the applications, and of course the number disappointed, that premiums of twenty guineas have been offered, and would be given, for berths on the first refusal of vacancies from parties who by any accident might be prevented from going. In one instance, a party having engaged a double berth, was written to in Devonshire, to request accommodation for a passenger, if the whole were not absolutely wanted. The directors have fitted up every yard of disposable space on the deck, as well as below, in order to make room for the number stated. Upon the eighty-seven passengers home, and the 130 out, at 40 guineas passage money per head in the saloon, and 35 guineas cabin, each way, the Directors of the Great Western will have received therefore, upwards of 8,000*l*, exclusive of the benefit derived from the conveyance of goods, of which the Great Western brought from New-York to the extent of about 200 tons measurement.'

"The Liverpool Albion says, that the last trip of the Great Western netted 6,000*l*, after deducting the 'keep' of the passengers. The trip occupied 29 days.

"The *Royal William* was to leave Liverpool on the 20th, and the new steam ship *Liverpool* has been purchased by the same company, and will sail on the 20th October. We may look for the former in ten days, so that our doleful anticipations of a cessation of steam navigation will not be realized.

"We also learn that advices received by the Western, from the Secretary and Directors of the British and American Steam Navigation Company of London, state that the British Queen is expected to be at sea in November. The company have ordered 1000 tons of coal, now on the way to this city from Liverpool and Scotland, to supply the British Queen.

"The steam ship President was in frame, and would be ready for the station next summer or autumn.

"The Western has made this passage in 16 days, with much head winds and heavy gales, and has behaved nobly throughout. She made her passage out in 13½ days. The Royal William was but one day longer, the greater distance up the channel to Liverpool, just making that difference."

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## *Central Railroad.*

We notice the arrival of the Shannon with upwards of 500 tons of iron rails for this road. We understand that another cargo of about the same quantity is on its way, and may be expected here in a few days. These parcels, with the iron now at the depot, will lay upwards of 80 miles.—We learn that the contractor for laying superstructure is now at work on the forty-seventh mile of the road. In the course of ten days, passengers to Macon will be carried on the road 40 miles; and cotton will be transported on the 15th day of October, from the Little Ogechee 46 miles from the city. The work has been going on briskly during the summer, and we hope to see, in the course of the ensuing month, from 1500 to 2000 additional laborers on the road.—*Georgian.*

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*Description of the Construction of the First Division of the Long Island Railroad, with Remarks. By an* ENGINEER.

(Continued from page 188)

To ensure the regularity and maximum accommodation desired, there must exist two species of turn-outs, or passing places, the one species such as exists at present for the accommodation of local business, the other species must have in view singly the accommodation of the greatest amount of long business on the road, or the non-interference of the trains, by regulating their passing places, so that at the time of starting the points of meeting shall always be known; this can only be effected by making these places correspond with certain divisions of time, hours or half-hours, and by determining an uniform rate of speed for all the engines at all times; or, if it should be necessary to have two descriptions of engines on the road, and two degrees of speed, that there should be two sets of passing places to correspond. To illustrate our meaning, we shall first suppose that there is but one class of engines, and one rate of speed admitted, and shall locate the passing place to correspond with hours. On the Long Island Railroad, any given uniformity of speed will be interrupted on the distance between Brooklyn and Bedford, where horses are at present used; this part of the road comprising four miles, will be left out of consideration; being situated at one end of the road, it will not interfere with our reasoning concerning the remainder; the number of horses maintained there must always be sufficient to meet the maximum trade; and there are two tracks laid on this portion of the road.

The accompanying diagram No. 1, will explain what is meant more clearly than any description: the figures at the top and bottom, correspond with the hours of a day, the figures at the ends, indicate the distances in divisions of ten miles each; the road is assumed as 100 miles long; the distance between Brooklyn and Bedford, travelled by horses, being four miles, the remaining distance to be travelled by engines, is 96 miles; 96 miles then, is the space to which the lines in the diagram are confined: if the rate of travel is 20 miles an hour throughout, and there being no high inclinations, there can be no difficulty in maintaining this uniformity of speed on this road, the time per mile will be 3 minutes, the time for 96 miles, 288 minutes, or 4 hours 48 minutes: if the engines are ready to start from Bedford at the beginning of any hour, they will have reached the other end in 4 hours and 48 minutes. I have supposed them to start from Bedford at 12 minutes *after* any particular hour, by which arrangement, they will reach their destination at the end of an hour; if the start be at 12 minutes after 6, the eastern termination will be reached at 11 o'clock; any other arrangement would answer equally well, provided always the intervals between the starts at either end correspond with the times for which the diagram is prepared, in this case, to hours; here, since the time has been assumed at Bedford at 12 minutes after any hour, it must be 12 minutes after 6, 12 minutes after 7, 12 minutes after 8, 9, 10, 11, &c., and at the eastern termination, with corresponding intervals of an hour, in this diagram at 6, 7, 8, 9, 10, &c. The upper horizontal line shows the Bedford end of the road, the lower the Eastern end; the intervening dark diagonal lines indicate the courses of trains starting every hour from either end, and travelling at a rate of 20 miles an hour; the points of intersection of these lines show the points where the trains would meet, and where, therefore, it would be necessary to have turn outs: if a train starts from Bedford in the upper line at 12 minutes after 4, (the distance being 96 miles, and the time 4° 48″) it will reach the lower line or Eastern end at 9 o'clock; if there were trains on the road coming in the opposite direction, and which had started from the opposite end at intervals of an hour, it would meet nine of these trains at the points G H I K L M N O P, distant ten miles apart; there would require, therefore, to be nine passing places, each distant ten miles apart. The velocities of the other trains being uniform, and the same as this, and the times of starting as already said at intervals of an hour, it could not possibly meet any greater number of trains; nine passing places would, therefore, under this arrangement, be the maximum; the road, however, would probably never be occupied by so many trains, and the number of passing places might, therefore, be reduced to accommodate simply the number of trains required for the maximum business of the road; this arrangement would very well answer on an inland road, but the times of the steamboat trains on this road being always uncertain, all the turn-outs would be required to meet this evil, and to enable trains to start from the steamboat end at intervals of an hour, without interfering with, or encountering any other trains which might be on the road, and which would only be on the road in accordance with the regulated times, and would therefore in all cases, be met at one or the other of the passing places, and only there. If the intervals of an hour should be found too great, and they probably would not, intervals of half an hour might be adopted from the steamboat end, by which arrangement the number of passing places would require to be doubled. The immense amount of business which such a system would accommodate, will be at once perceived.

We shall now consider the effect which a second description of trains, with a different speed, would have on this arrangement. Suppose that it were desirable, in addition to the trains moving at 20 miles an hour, to have another description moving at the rate of 15 miles an hour; the time occupied on 96 miles in this instance, would be 384 minutes, or 6 hours and 24 minutes; and observing the same intervals of time in starting, and securing the full hour at the Eastern end, the dotted lines will represent the courses of this new series of trains, and the mode in which they would interfere with each other; and with the trains moving at 20 miles an hour, the courses of which are represented by the full black lines. The number of intersections, and consequently, the number of passing places required, would be under this arrangement 30; with such a system and the road fully occupied, there would be too much time lost at the passing places, and the trains would not be able, probably, to maintain their given speed. This, however, could never occur in practice, for were the business so extensive, it would be more than sufficient to maintain two tracks. If, however, two speeds were admitted on a road, such as the Long Island, the same uncertainty consequent on the steamboat

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arrivals, already adverted to, would still require this full number of passing places, although the trains daily moving from either end, might not exceed five or six: we should have to provide, therefore, for the contingency of a meeting during the day at least, (for during the night, the 15 mile trains would not be in operation,) of the second description with any hour of starting, the number of passing places, would not, however, affect the time of the engine, since they would not come into operation probably more than four times in the course of a trip; engines and carriages, however, are always more liable to accidents at the passing places, than on any other portions of the road; the less numerous they are, therefore, the better, and hence, the great advantage which would accrue from having but one rate of speed for all trains, whether carrying freight or passengers; in the one case, the number of passing places would be nine; in the other case, thirty; the same number of trains could be on the road in the first case, as the second, and the intervals of starting would be the same, the greater speed of one portion of the machinery would induce a greater expence for repairs in proportion, but this might be fairly set against other advantages which accrue from the single rate; the reduced liability to accidents, the uniformity in the construction of the machines used, and the saving of attendance at the turn-outs.

The diagram No. 1, may be viewed as a table showing the operation of the trains at any point of the road; the scale of passing places at one end, and the corresponding letters will further illustrate it.

Reference will now be made to diagram No. 2, for the purpose of appreciating the effect of a given amount of business on the road, on the same system; we have there supposed eight trains to leave either end of the road daily, an amount of travel and business which would probably exceed the average demands for many years to come; of these eight trains, four are intended to accommodate the Boston business, two for passengers, and two for freight, and these are supposed to travel at the rate of 20 miles an hour; the other four are intended to accommodate the island business, two for passengers, and two for freight, and travel with a speed of 15 miles an hour. The letters A B C D, indicate the times of starting of the Boston trains from Bedford, the accented letters A′ B′ C′ D′, the times of starting of the Boston trains from the Eastern end, and moving towards Brooklyn. The letters E F G H, indicate the times of starting of the accommodation trains from Bedford; the accented letters E′ F′ G′ H′, the times of starting of the same description of trains from the Eastern end.

The intersections of the lines marking the courses of the different trains, show the passing places required; these, under this management, would be 13, but this limited number of passing places would not admit of that variation in the times of starting, which, at the Eastern end, must always exist; although, therefore, not more than thirteen turn-outs would be in operation in one day, there would be the full number (30) required to meet the irregularities of the Eastern end, and accordingly, one turn-out would be in operation one day, and another another, corresponding with the starts.

We now refer to diagram No. 3, which exhibits the manner in which the same number of trains would be accommodated, on the presumption that these trains, instead of travelling with different velocities, travelled with one and the same velocity, viz: 20 miles an hour: in this case, the distances between the turn-outs would be equal throughout the road, in the other case, the positions of the turn-outs are very unequal. To meet this particular amount of business, nine turn-outs would in diagram No. 3, be required, there being nine intersections; if we add another turn-out, there will be ten in all, distant each ten miles apart, and this number of turn-outs would accommodate as well, all changes in the times of the trains, and all additional or extra trains occurring at intervals of an hour. If lines be added to the diagram for trains starting at any other corresponding hours, such as 12 minutes after 8, or 9, or 10, from the Bedford end, or at 7, 8, 9, &c. from the eastern end, it will be seen that they do not elicit in their intersections, any new positions for turn-outs, but that they will always be comprehended under one or other of the ten turn-outs already mentioned, and the positions of which are exhibited in the diagram by horizontal lines, corresponding with the figures for miles. Such an arrangement, therefore, it will be seen, would accommodate a much greater amount of business than is likely to exist for some time to come, and such an arrangement, therefore, with a single track, or, that explained in diagram No. 2, is assumed as amply sufficient to accommodate the demands of the public, and satisfy the purposes of the road.

Recollecting the remarks which led to the above considerations, relative to the capacities of the road, and having in view the entire adequacy of a single track arranged as above, I shall now proceed with my object, which was to introduce a more perfect system of drainage, without increasing the outlays usual at present, and also without impairing the efficiency of the road in respect of accommodations.

It will be proper to consider first, the value of the present width for the purposes in view. Fig. 1, represents the road in cutting, and the manner in which its width is disposed of; in conformity with the fact of its being graduated for a double track, the single track laid occupies one side of the centre line, and the space on the other side is in the meantime unoccupied. This unoccupied space is frequently appropriated, especially when there is no prospect of a second track being required for some years, towards securing a depth and width of drain, which the legitimate side does not admit of. This mode of draining, however, is contingent and temporary, and will not militate against our assertion, that there does not exist a sufficient provision for this purpose, if it is true that the legitimate side, or space, belonging to the side of the track *laid* is inadequate. I observe, first, that the intention of the drain being to prevent the water from remaining and settling in the superstructure, the level of the bottom of the drain should be below the level of the bottom of the superstructure, otherwise, when, during rainy weather, the drain is full of water, that water will naturally find its way below, and among the timbers of the superstructure, instead of being drawn therefrom when existing there. 2d. The superstructure is always supposed to rest on a foundation of gravel or sand, or broken stone, and it is important that this foundation should at all times be free from moisture; this foundation for the superstructure, we shall estimate at nine inches in depth. When the natural earth is not of this description, it is usual among engineers now, to remove that earth, and replace it with suitable materials: the bottom of the drain, then, ought not only to be below the bottom of the superstructure, but below the bottom of this foundation. When the earth, on which this foundation rests, is clay, the importance of this assertion will be sufficiently obvious; when the earth is itself very good gravel, or sand, and which admits, therefore, easily of the percolation and passage of water, the water not being retained so long, the evil produced will be proportionally less.

On the first division of the Long Island Railroad, the stuff is of this nature, but on the remainder of the road, every variety will occur: 3d, the sides of the drain must have a certain slope, and be formed of a material not easily removed by water, otherwise they must be continually breaking, caving in, and hence, the drain filling up. The natural slope of sand is 1½ to one; in gravel or sand, therefore, the slopes cannot be less for drains, but this slope will not be sufficient, for no earth can maintain the same slope when wet as when dry, and wet sand or gravel will not maintain a slope of 2 to 1, far less 1½ to 1. Sand and gravel, however, unless the gravel be very coarse and heavy, are easily displaced and removed by water; the particles possess no cohesive properties, nor are their component parts sufficiently massy to enable them to resist the action of water, hence the slightest current removes them from their position, and it is well known that no ditch, cut through sand or gravel, maintains its form for any length of time; these substances are therefore entirely inappropriate.

The side drain A, of fig. 1, is shown in figures 4 and 5, on a larger scale, marked there *a'* and *a''*: in fig. 5 *c* (and *c* on fig. 2 and 3,) shows the sills and additional pieces laid at the junction of rails; B shows the mode of laying additional pieces at the junction of sills, and in fig. 4, D shows the mode with two sills, dispensing altogether with the additional pieces; in the first instance at C, the bottom of the drain, when in its perfect and best state, is six inches below the bottom of the sills; in the second instance, at B, the bottom of the drain, if 4-inch plank is used, is two inches below the bottom of the sill, or three inches with 3-inch plank; in the third instance, at D, the bottom of the drain is three inches below the bottom of the sill. Again, and on the supposition that there should be nine inches of sand or gravel below the sills, and that this portion, or immediate foundation, should be always as exempt from moisture, as the nature of the case will admit; the line *m* of fig. 5, will correspond with this depth for the track laid with single sills, or when additional pieces are not placed below, as at C, and this line or depth will then be found three inches below the level of the bottom of the drain, as represented in its best state, the line *m'* corresponding with the mode B, will be seven inches below the bottom of the drain, and the line *m''* corresponding with the mode D will be six inches below the bottom of the drain. We see, therefore, that if the form of the drain could be maintained in sand, and it cannot, it would always, when occupied by six inches of water, flood the planks, and would necessarily be entirely ineffectual as a drain in removing water from the gravel or sand, or broken stone, on which the plank rests. In summer, the sand would become soft and pliable as quicksand, should there happen to exist a stratum of clay below it; in winter, the same, or any materials, would, by the action of frost on the water, be swelled and distorted, and the superstructure with it; but the drain will rarely be found in the perfect state in which it has been supposed; a days' rain will rapidly obliterate all trace of a drain formed in sand or gravel, and as the damage done by the choking of the drains is rarely perceived until the rain or storm is over, the evil has reached its limit before it is known.

The mode in which the water acts on sand may be generally understood from the sketches of the same drain *a'' a''' a''''*, where *a''* shows how the water first encroaches on the slope, and the side of the drain next the track, *a'''* where the slope has slightly slipped and filled up the drain, and *a''''* where, after a repetition of the previous process, the slope has slipped more extensively, and reached the rail. Those who have travelled on the Camden and Amboy Railroad, the Washington Railroad, or indeed on almost any other Railroad in the spring months, must have observed instances of this description; at least they must have observed the gangs of men at work there, on the ditches and slopes of the deep cuttings, repairing such slips; generally it is true, the slipping has been occasioned as much by improper steepness of slope, but either defect is sufficient of itself to produce this evil. It is very evident, then, that it is not sufficient that the ditches be of the requisite size and depth, unless they are lined with a material which will maintain the form originally given, while they are subjected to the action of water. In the case of the ditches before us, the size and depth are insufficient, if the materials of which they are composed were good. These, however, are equally inappropriate and unavailable, and until a better system is introduced, the same interruption and expences must be met every spring, as occur now to so great an extent on nearly every road in operation. I shall now propose the correction of both of these evils, by way of inducing at least that consideration which the subject deserves.

It will be borne in mind that I do not propose to eradicate the evils and expences attending the present system, without incurring additional outlay for the same *nominal* extent of convenience; that is, comparing a single, as modified, with the present single tracks, double with double. I shall indeed endeavour to show that in this instance, no additional expense will be incurred, because a single track is competent to do all the business required; the second track, therefore, instead of being provided for now, is altogether deferred, and the expense attending the improved system desired to be introduced, is compared with the expense attending the excavations made at present professedly for a double track. If this has been already sufficiently explained, the repetition of it here must be ascribed to the aversion to any thing like that quackery which would offer an important improvement at no additional cost That the advantage can be gained in this instance, without additional outlay, is the consequence of the previous neglect of advantages in arrangement, by which the suggested improvements in this respect, if my ideas are correct, will balance the additional outlay, which (with a double road) would otherwise have been necessary for a better system of drainage. I may make myself more plain, when I revert to the width at present adopted on single tracks, which is either 16 or 18 feet; the road proposed, is essentially a single track, but the width required, will be 23 feet; if, however, all the business of the road can be very sufficiently accommodated by a single track, then the money which would have been otherwise employed and expended in grading for a double track, with very imperfect drainage, is proposed to be applied to the perfecting and securing the single track from the interruptions and expensive repairs incident to a double under the present system.

Fig. 15 shows one half of a single track, as proposed to be improved; the dark line *n n n* and corresponding slope, show the manner in which the road would be graded in a gravel cutting. If the excavation was clay, and it was therefore required to place nine inches of gravel on the surface on which to lay the superstructure, the dotted line *o o* connecting with the dark line *n n* would then show the form which the grading would assume. For the present, and with the view of comparing the expense, we shall suppose it to be gravel, since with any other earth the other process of removing nine inches, and replacing by gravel, would be common to both systems, and indeed would be more costly on the present, than the one proposed. During the process of excavation, all stones, or at least a sufficient quantity for the intended purpose, of from three to four inches diameter, would be laid aside. When the graduation had been completed according to the dark lines, these stones lying in the excavation in heaps at short intervals, would be applied towards lining the side drains for nine inches in depth, as shown in the sketch. Their size and weight would enable them to withstand any flow of water likely to occur, or at least any quantity which the size of the drains will admit. These stones being laid with a moderate slope of $1\frac{1}{4}$ to 1, which is sufficient for such gross materials, and being individually large and heavy, may reasonably be expected to maintain the original form given to the drain, with but little repair for a great length of time; they would prevent the action of the water on the inside next the sleeper, and would therefore exempt the sleeper and sill from being undermined, instances of which occur occasionally at present. On the slope side, they would prevent the water from infringing on the bottom of the slope, undermining on that side, and would therefore, thus far exempt the slope from any liability to slip, provided it were originally formed, with an inclination such as the nature of the earth opened should require: the side drains having been thus completed, catch water drains are cut along the tops of the slopes, to intercept the surface water from the fields. These small drains are of great service to the slopes, by preventing the surface water, which sometimes collects in considerable runs, from flowing down and disfiguring them. This object will be still further secured by laying the stuff removed from the catch water drains in the form of a small mound between the top of the slope and the drain; the fence should be placed outside of the drain, that the company may always have the power to use and repair it, as circumstances may require. The graduation and draining having been thus far perfected, the superstructure is laid on the line *n n* of any proportions required. It should not, however, be sunk into or under the grade, but simply laid on it, rammed solid as usual, and the track afterwards filled in hard with gravel to the surface of the sleeper; the bottom of the sills will then be twelve inches above the bottom of the drain. The stones forming the sides of the drain being large, will obviously allow any water to pass freely from the gravel below the sills into the drain, and the frequent communications from the surface of the road, laterally to the drain by little open cuts between the sleepers, will, to a great extent, prevent the water from reaching the gravel foundation.

Figure 16 shows a mode of forming the side drains, which might be found convenient where stones were very plenty in the excavation, or when land was of sufficient importance to render a few feet less width of ground an object; the width necessary by this mode, would be three feet less than by the other; fig. 15 would require 23 feet of roadway, and fig. 16 only 20: when the excavation was through rock, something of the same form of road-bed would be proper.

In both of these figures, there is but one half of the track shown, the other half being in every respect similar; C is the centre line in this case; should space for a double track, at a future time be required, the dotted lines on either section, will show the relative positions of the side drains, and the additional width to be excavated, $c'$ and $c''$ in this case becoming central points; the additional width required, would, in either case, be 11 feet; this excavation would always be taken from one side, and as the space occupied by the drain might be occupied during the operation, there would be ample room to work either carts or cars, without interfering in the least with the business of the road. If a space of four feet from the near rail was secured, to avoid any interference with the existing track, there would still remain 16 feet of space in which to excavate without interruption.

It will now be proper to submit an estimate of the expense, from which a comparison can be made: for this purpose, we shall assume 12 feet as an average depth of excavation on the road, and estimate for 100 feet of length. This depth will probably be a minimum, and the greater the depth the greater will be the difference in quantity and expense in favor of the mode proposed: we refer simply to fig 15.

| | Cub. Yds. |
|---|---|
| Excavation 12 feet in depth and 23 in width, for 100 feet of length as per fig. 15 - - - - - - - | 1822·2 |
| additional from side drains, - - - - - - | 40·7 |
| | 1862·9 |
| Excavation 12 feet in depth, and 26 feet in width, for 100 feet of length, as ordinarily assumed for a double track, | 1955·5 |
| additional for side drains admissable on this system, | 11·1 |
| | 1966 6 |
| The difference, - - - - - - | 103·7 |
| We shall assume the price in either case, as 20 cents per cubic yard, including the haul into an embankment, which, as an average price, is probably a minimum. With 26 feet width, then 1966. cub. yds. at 20 cts. | $393 32 |
| For the single track as proposed, and with 23 feet of width, we have 1862·9 cubic yards at 20 cts. - - | $372 58 |
| The stones laid aside for the drains having been already paid for as excavation, the laying of these, using wheelbarrow and spade, may be estimated at 75 or 20 cents, say 20; 38·8 cub. yds. of stones laid at 20, | 7 76 |
| | 380 34 |
| Difference in favor of the mode proposed, - - or $685·34 per mile. | 12 98 |

In the proposed width of 23 feet, by which the comparison is made, the soiling of the slopes has been kept in view, and the additional width necessary to this end secured; the soiling of the slopes, and seeding them, is, with all earths, and on all roads, a necessary provision against slipping and running, and the outlay necessary to effect this end, as well as any additional outlay for draining, is not an expense incurred to obviate remote, and therefore it might be said, superlative repairs; but repairs demanded yearly and monthly, and which are not prospective deductions from the revenue, but immediate in their operation on the yearly dividends of the road; the ditching, or draining, it is obvious, can never be secure while the slopes are insecure. It has already been said that the only slope which maintains its form on the first division of the Long Island road, is the one slope which was soiled, and whose surface has become firm and secure against even the most violent rains: the security afforded by soiling the slopes, is generally so perfect and so beneficial in its results, that the practice must very soon be universally introduced; it prevents the stuff from slipping into and obstructing the ditches, it is therefore necessary to their proper action; it prevents the encroachments on the adjoining property which not unfrequently occur from the slopes breaking and falling in; it secures for the same reasons the stability of the fences and obviates the inconvenient repairs attending them, and the damage which ensues from their insufficiency by the escape of stock upon the rail road; it reduces in common with the improvements in draining vastly the amount of occasional and uncertain labor required on the road, as well as the amount of daily attendance. When the slopes of an excavation are to be soiled, the soil is removed from the surface of the ground at the commencement of the excavation, and laid aside until its completion, when it is thrown upon and spread over the slopes; the slopes are then immediately seeded. The proportion of stuff laid aside for this purpose having been already estimated and paid for in the estimate for the number of yards entire in a twelve feet cut, we have only now to add the expense of replacing it on the slopes, but the price already paid for removing it was 20 cents, which supposes a haul of some distance with cars or cart; the laying it aside, however, was not worth more than 12 cents, and the additional 8 cents we must take into account now under the expense of replacing it; the expense of replacing and spreading it may be worth 16 cents, or including the seeding, say 20 cents; taking 8 cents from this, we have 12 cents as the proportion now due for the additional labor; the slopes will contain 13·2 cubic yards for 100 feet of length, equal to at 12 cents $2 64; the difference in favor of the 23 feet width proposed, including the expense of drainage, when compared with the 26 feet width was shown to be $12 98 in 100 feet; if from this we deduct the $2 64, there will still remain a favorable difference of $10 34 or $545 95 per mile. There remains, however, still another deduction to be made from this amount, on account of the additional width which will be required at the passing places; this deduction will depend on the length allowed to these passing places; if their lengths be estimated at 1000 feet each, that they may be enabled to admit more than one train, and if they occur every 10th mile, the proportion per mile on which the increased width will occur, will be 100 feet; if we summarily estimate the cost of grading at $12,000 per mile, this will amount to about $200, and the result in favor will then be $200, subtracted from $545 95, equal to $345 95 per mile. The turn outs for the accommodation of the local trade can always be located at the terminal points of excavations, and the additional expense incurred by these will therefore form but a small fraction of the cost of graduation.

If, then, I have been able to express clearly my own views, I have sought to establish first, the insufficiency of a width of 26 feet as a double track for the purposes of drainage and the safety of the road; next the sufficiency of a single track, for any amount of business likely to occur on this road for many years, even should the travel and transportation equal that of the Boston and Providence rail road, and it will not probably exceed it; and again that in view of a single track being sufficient, the defects inherent in the present system (for want of space) may be removed and the drainage rendered very complete at an expense less by $346 per mile, than the cost under the present system when the road is confessedly imperfect, and although graded with a view to a double track, more than one is not intended to be laid or used, while one will at all accommodate the trade. The advantage will be, that the same amount of trade being accommodated by the perfect as by the imperfect system, a great amount of a annual expense for occasional repairs, delays and accidents, will be saved and the yearly dividends be proportionably increased.

(To be continued.)

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From the Southern Recorder.

*Office Board of Commissioners—Western and Atlantic Rail Road.*

MARIETTA, July 14th, 1838.

To His Excellency G. R. Gilmer: Sir:—In consequence of the absence of Major Joel Crawford, President of the Board, from the State, on important business connected with the interests of the Rail Road, the duty has been devolved upon me, of making a quarterly report of the progress of the work, and the condition of the road, entrusted to the care and direction of the Board of the Commissioners for second quarter of the current year.

In the early part of April, contracts were entered into for the grading of upwards of fifty miles of the road, and the work of construction has been progressing at an increased ratio up to the present month; and from the report of the superintendant of construction, and the character and competency of the contractors employed on the work, the commissioners have the best assurances that the grading of that part of the road, now under contract, will be completed by the first of July next. The scarcity of provisions in the section of country through which the line of the rail road passes, and the difficulty of procuring efficient laborers at this season of the year, has necessarily retarded the operations of the contractors, and the amount of work done on the various sections under contract, has fallen short of the anticipations of the board, but it is confidently believed, that after the labor necessarily bestowed upon the growing crops are completed, the services of laborers will be procured on reasonable terms, and in such numbers as will answer all the exigencies required for the completion of the work within the time specified in the contracts.

The amount of expenditures during the second quarter of the current year, on account of constructions for road, formation, masonry, bridge timber, cross ties, right of way, and pay of engineers engaged in the constructive department of the service, agreeably to the pay roll, as exhibited in the return and abstract of work done in the month of April, May, and June, with the vouchers for the several amounts paid, is herewith submitted, together with the vouchers for the expenditures incurred during the first quarter of the year; and also the quarterly report of the chief engineer, to which I respectfully beg leave to refer your excellency, for a full and comprehensive view of the condition and progress of the work, and for other important information connected with this great work of internal improvement.

The commissioners have been untiring in their efforts to procure the right of way, on the route of the Rail Road, and have succeeded in obtaining deeds of concession from nearly all the resident landholders in the counties of DeKalb and Cobb, on terms deemed reasonable; and in cases where exorbitant damages have been demanded, recourse has been taken to arbitrations, or the final award of special juries will be resorted to. In the prosecution of this delicate and unpleasant business, the commissioners have met with difficulties and obstacles little to have been anticipated in the commencement of the enterprise. As the construction of this great work was obviously intended for the special benefit of that portion of the Cherokee counties through which it runs, it was confidently believed that the citizens of those counties would have vied with each other, in setting an example of liberality and zeal, in forwarding the progress of the work; and as the lands on the line of the road were enhanced in value by reason of the contemplated structure of the road; the land owners would have considered that enhancement of value, an ample compensation for the concession of the right of way, occupied by the space of the road, and any other inconvenience they might be subject to, in consequence of the structure of the road formation; but it has had a contrary effect upon many of the land holders, who now demand compensation for the land to be occupied by the road, and damages at a rate proportioned to the increasing value of the land. There are, however, some honorable exceptions, as we advance upon the line, some are found who are disposed to act the nobler part, and consider the benefits that themselves and their neighbors will derive from the road ample compensation for the sacrifices of a small portion of land and materials employed in its construction; instances of this highminded and generous bearing, may be found at the Chattahoochie river, Marietta, Etawab river, and at several other places.

The board have resolved to offer an additional portion of about fifty miles of the road for contract, from the 8th to the 13th of October next, beginning at the sixth section of the third division, and extending to the valley of the Conasauga river, as indicated in the chief engineer's quarterly report, above referred to. By the adoption of this measure, a larger field of enterprise will be opened to our citizens, and a greater point of attraction be given to industry and enterprise; and as the time of letting will take place at a season of the year when the great business of agriculture will have been completed for the year, slaveholders and others engaged in the farming interest, will have an opportunity of making their arrangements, so as to employ a large portion of laborers in the rail road service during the fall and winter months, a business deemed much more profitable than the growing of cotton, at the present low prices of that staple article of the southern states.

The route of that portion of the road, about being offered for contract, traverses such a level region of country, and the work of construction will be so light, that the grading will doubtless be completed nearly as soon as that portion of the road under contract; and will enable the chief engineer to employ to advantage the services of that portion of the côrps of engineers now about to engage in the survey and location, to the Tennesee river, after that work shall have been completed, which is intended to be effected by the time of the next letting. The residue of the road, about forty miles, can be placed under contract, in time to be completed before a supply of iron can be procured from Europe, or at least put in such a state of forwardness, as to offer to the commissioners the option of commencing the laying of the foundation at the terminus in De Kalb county, or at the Tennessee river, as future exigencies may dictate, or a sound and economical policy may require.

It is believed that iron can be transported from Ross' landing, on terms much more favorable than can possibly be afforded from Savannah, to the terminus in De Kalb county, having to encounter the heavy expense of transportation in wagons over a considerable portion of the route. The commissioners will, however, give to this subject that mature consideration its importance demands, and adopt the course which may seem most conducive to the public interest. The getting of sleepers, or cross ties for the railroad has been measurably suspended, except on the immediate line, or space occupied by the road, the season of the year being unpropitious for the cutting of the timber to be used in contact with the ground; and as the process of Ryanizing timber for railroad purposes, attracting public attention, the commissioners are desirous of giving the subject a thorough investigation, and if the result of their inquiries should be favorable as has been represented, and the cost of the process not being greater than eight or ten cents a piece for ties of eight feet long and six inches square, good economy would dictate the adoption of the process, as timber can be sawed with great neatness and accuracy by steam saw-mills placed on the line of the road, and cost less the Ryanizing process included, than the old method of selecting and hewing heart timber; as any description of timber answers the purpose, the process alluded to, rendering it impervious to putrefaction or decay.

It affords us great pleasure to state to your Excellency, that from information derived from an autheniic source, the most perfect good feeling prevails on the part of the Stockholders of the Hiassee Railroad Company, toward the authorities of Georgia, and that they are pressing forward their work with a zeal and energy commensurate with the importance of the undertaking. Regarding this road as a valuable auxiliary to our great State enterprize, I cannot refrain from expressing to you my deep solicitude for the prosperity and final success of the Hiwassee road. Running from Knoxville, a distance of ninety-five miles, to the Red Council Ground, on the Georgia boundary line, a junction with the State road can be effected by a branch of not more than fifteen miles in length, and cannot fail to be as advantageous to Georgia, as it will be profitable to the Stockholders of the company. This branch should be constructed by the State, as it will be within the limits of Georgia, and cannot fail to enhance the value and importance of both roads, and tend to unite the interests of the people of each state, and to strengthen the bonds of union and good neighborship.

I beg leave to remark, that should the Legislature of Georgia at their next session, continue to pursue the wise and patriotic policy, that has actuated their councils for the last two years, in regard to the works of internal improvement, and afford the necessary facilities for carrying on this great work to a speedy and successful consummation, two years more will not elapse before the state will begin to realize the benefits of this politic and enlightened legislation. In estimating the future advantages of this road, allowance should be made for the constant advance of the country through which it passes in population and business. The fertile regions of the western counties are rapidly filling with a wealthy and enterprising population, and increasing in their business, wants, and capacities. The Western and Atlantic Rail Road will form the main link of the great chain of rail-way communication, from the southern Atlantic cities to the populous regions of Tennessee and North Alabama, and furnish a thoroughfare for travel and freight unequalled in the southern states.

The consequence must be, that when the several branch rail roads, now in a train of execution, are completed, the amount of business that will be done on the road, will far exceed any calculations that have been made upon the facts, as they have heretofore existed; and this rail road will naturally become the main thoroughfare between the western states, and the commercial cities of Georgia and South Carolina.

Very respectfully, your obedient servant, CHA'S I. BOLTON,

*President (pro tem.) Board of Com'rs.*

*Extract from the Address of George Peabody, Esq., President of the Eastern Railroad Corporation, on the opening of that Road, August* 27, 1838.

It is but little more than two years since the ground was broken for the commencement of this Road, and that part is now open for travel which is considered altogether the most difficult of construction, and attended with the greatest expense.

This rapid progress under ordinary circumstances would have been a matter of surprise, but is still more so when we reflect that it has been made during a compression of commercial affairs unprecedented in this or any other country; a condition of things which, we may venture to assert without arrogance, would have convulsed Society, and revolutionized Government, in any civilized nation of the old world. Yet, with all this acceleration, it is believed that no part has been slighted. Every improvement which experience could dictate, or ingenuity suggest, has been adopted, and the Road constructed with special reference to strength and durability.

But we are not to be the sole judges of our labors. They are to be submitted to a competent tribunal. The public, whose comfort and security are to be essentially affected by them, will soon decide how far success has crowned our exertions.

The last twelve hours have produced an important change in the relations of Salem to her flourishing neighbor, the metropolis. Her condition to-day is very much the same as if some invisible power, during the night, had removed the town, with its unconscious inhabitants, about ten miles to the southwest. We could almost fancy that there was more truth than fiction in the magical incantations ascribed to her ancient inhabitants—and that the old witches of 1692 had actually come back, to play off their pranks on a good wholesale system. Notwithstanding the employment of every means hitherto understood to shorten the distance between the two places,—a Turnpike, second to none in excellence, and a superior line of Stage Coaches,—yet it is now reduced nearly to one third of what all these could accomplish. We think there will be no cause to regret the change, and that the expectations of our citizens will be fully realized. When this project originated, much anxiety had for some time been felt lest the old lines of accommodation were to be broken up, and that Salem, instead of being an important point in the transit of passengers to and from the East, would be completely isolated, and lose her comparative standing.

Her citizens perceived that great exertions were making for the construction of a Railroad, which was intended to divert the main travel to the interior, and to deprive her, as well as the other towns on the seaboard, of the advantages they have enjoyed since the settlement of the County, of being in the direct channel of trade and communication with the East. They could not calmly regard such a contingency without making some effort to avoid it.

A subscription was first opened for a Railroad from Salem to Boston, and papers were circulated for another in continuation to the East. But it was soon thought advisable to unite the two, and the project in the latter form was favorably entertained by many of the principal towns in the county, where a great number of shares were taken.

The proprietors of East Boston, who had a few years previous made an unsuccessful application to the Legislature for a charter to build a road to Salem, were induced to subscribe largely to ours, as soon as they ascertained it would be located through their Island. The success of the enterprise is in fact very much owing to the large interest taken by these gentlemen, and we hope their spirited action will be compensated by a full share of the anticipated benefits. The object sought for, we believe, will now be achieved, since there can be no doubt of the extension of this Road to the confines of the State; and sooner or later to the extreme Eastern section of the Union.

If the only consequence of the Road to Salem is to secure to her what she at present possesses, it will accomplish a truly valuable purpose; for she has much to lose. Few towns can boast of so many solid advantages. We think it can be said with truth that none of the same population can be named where so large a proportion of the inhabitants enjoy the means of comfortable living, and where exists more intelligence and morality. Exempt from the many evils incident to a great city, she possesses every substantial benefit.—All the ordinary sects of religion here find sympathy, and ample accommodation for public worship—Charitable and humane institutions exist nowhere in greater number or on a more respectable footing. The man of literature, science and taste, may here have access to an Athenæum containing one of the choicest libraries in the country, to an excellent collection of Native Antiquities, and to the fine Cabinets of the Society of Natural History and the East India Museum, the latter of which contains, as is well known, a collection of rare and valuable curiosities, equal, if not superior, to any of the kind in Europe or America. With a government that scrutinizes every expenditure, a well regulated police, a most liberal provision for public instruction, elevating the character and condition of the common schools—with comfortable and airy dwellings, clean streets, and though last not least, a fountain of the purest and softest water, supplying in abundance the utmost wants of the inhabitants, and pouring health into her borders:—with blessings like these, and others innumerable, we may venture to repeat, that old Salem has much to lose. Her citizens may rest content, if the strength and character of her population are unimpaired—if the means are preserved for the maintenance and continued enjoyment of such institutions—if the timely adoption of a generally acknowledged improvement should be effectual in retaining her merchants and others, whom the commercial advantages which other places afford might tempt to desert her. Owing to the general extension of commerce and the competition in trade, very little of the business of Salem is transacted at home. Her merchants, who by their early enterprise enjoyed nearly a monopoly of the East India trade, and could then dispose of their goods from their own warehouses, are now obliged to seek the great marts of the country for the sale of their cargoes; so that very few of the vessels actually owned in Salem ever enter the port. Their intercourse with Boston must necessarily be constant, and they will now be subjected to a trifling loss of time or money in their transactions. In fact, the cost of travel on the Railroad, if made use of every day in the year, would be less than the difference between the rent of a house in Salem and one of equal quality in Boston.

The ordinary time required to go to Boston over the Turnpike, may be fairly set down at two hours. If an individual were to visit Boston on Railroad only twice a week, and to save one hour each way over the old mode, his gain in a single year would be two hundred and eight hours; or, estimating the day at twelve hours, (for those lost are taken from the best part of the twenty-four, especially in winter,) he would have a clear gain of seventeen days; a saving of some consequence to an industrious man, and important to every one who has a just estimate of the value of life.

An expensive undertaking to deepen the water at the wharves in the South River, is now nearly finished, which, in connexion with the Railroad, may induce some of our merchants to store their goods at home; if not in the expectation that the Road will bring purchases, at least in view of the facility which it offers to convey their goods to market at any season of the year.

The continuation of the road through the county of Essex, will, we cannot but believe, add greatly to the profits of the enterprise, and materially extend its usefulness. It certainly would not be safe to proceed with a work of this nature, carried on by private subscription, on a mere theory of the advantages to result from it, and leave the subject of an income to some doubtful contingency. States may wisely enter upon projects where immediate benefits can be conferred for the sake of a supposed future and permanent good. But so great is the expense of constructing a durable Railroad, with every proper attention to economy, that the risk of individual loss is too serious when undertaken by private means, unless a condition of things can be shown, giving every promise of a profitable investment,—unless, in fact, a location is chosen between two towns having constant intercourse, or through a country containing a thickly-settled and busy population. If this view be correct, where can we look for a more favorable location than the projected line of the Eastern Railroad? The statistical returns to the last Legislature present a flattering exhibition of the resources and industry of Old Essex. These fall short of, rather than exceed, a correct estimate, and no account is rendered of the foreign commerce, which employs a large proportion of the capital of the country.

The Northern towns, viz. Amesbury, Andover, Boxford, Bradford, Haverhill and Methuen, are found to contain 18,000 inhabitants. Leaving out these towns, and also Lynnfield, Middleton, and Saugus, and not likely to make use of our Road, we have seventeen towns through which it really passes, or to which it will be easily accessible, with a population amounting to 74,000! No considerable part of this number will be found concentrated at any particular point, but the inhabitants are well diffused over the whole line of the road. Their pursuits are such as to create a constant intercourse with each other and with the metropolis. This activity arises perhaps from the circumstance, that the several branches of industry are conducted principally by individuals; there being but a small amount of corporate property in manufactures located in this part of the country.

The whole value of the cotton and woollen goods manufactured yearly, is estimated at $391,000, which, deducted from the general returns, leaves an annual produce of mechanical and manufacturing industry, carried on by private means, valued at $6,150,000, only $1,500,000 of which can be claimed by Salem. The Cod and Mackerel fisheries in seven of these towns yield a yearly value of $1,000,000, and is on the increase. When we consider, in addition to these, the extent of the Whalefishery, in which twenty-seven ships are now employed, and the immense capital invested in foreign commerce; the various mechanical pursuits dependant upon these, and the amount of labor required in Agriculture, we think we may safely conclude that the inhabitants of this part of Essex, at least, are not slumbering in idleness, and their occupations such, that every facility of intercommunication granted them must prove highly serviceable.

We believe a case is here presented where the construction of a Railroad, with any tolerable regard to economy, must yield a fair return to the projectors; and this, were it even to terminate within the county of Essex. But we are not to stop here.

The States of Maine and New Hampshire will, ere long, seek to unite themselves more closely with the capital of Massachusetts, and through that with the great States of the West and South, and in so doing they will naturally adopt the most obvious means. In a climate where winter reigns for six months of the year, the impediments which might arise from heavy snows, are too apparent to be disregarded in the construction of a long line of Railroad. In order that this should be serviceable during the winter season, at which time its great benefit is to be expected, the milder and less exposed regions must be sought. A seaboard route, in these States, besides being less subject to accumulations of snow and ice, would be more direct than one through the interior. So that, whenever the connexion is made, our Road, on this account, as well as on many others, will offer advantages which can be found in no other direction. We may, then, fairly presume that to-day is completed the first link in the chain which is to bind our good city of Boston with the East.

A short time only can elapse before Massachusetts will be so intersected with Railroads, as to leave but a small part of the State without the benefit of this great improvement. May we not expect the most propitious consequences from the change?

With the completion of the Eastern Railroad, the Taunton branch to New Bedford, and a route through Plymouth to Cape Cod, the seaport towns on the coast will be so united as to form as it were one great commercial emporium, the extremes of which will be only four or five hours distant from each other, and possessing a mercantile fleet of nearly one-third the whole tonnage of the United States, and equal to that of the City of London in 1832. The merchant of Newburyport may then meet his friend from New Bedford, on 'Change in Boston, and each return home to dinner with the greatest ease. The farmer of the interior will find the Great Western Road offering to him a speedy and economical conveyance to market for his surplus produce at all seasons; while the manufacturer, now depending for the transport of his goods upon navigation frequently closed for months in the year, will find a safe and commodious passage to the West, even in mid-winter. It is by encouraging works of internal improvement like these, by giving every aid to commerce and mannfactures, by promoting the frequent intercourse of her citizens, by countenancing every reasonable project for the benefit and extension of her Capital, in the prosperity of which her own greatness is involved; and by thus creating a just and patriotic sentiment of state pride, that Massachusetts can expect to retain her population, and to hold that political rank to which she is fairly entitled. Her sons must be made to realize that the fields of honorable exertion are still open at home—that the barren soil on which their eyes first opened, has proved a blessing rather than a curse, by arousing the energies, quickening the invention to provide the means of subsistence, and calling into action every power of mind and body.

Where the earth spontaneously pours forth its fruits, man becomes slothful and degenerates. The fertile plains of the South and West may tempt their imaginations with the vain hope of competency and ease, but can yield no product compared with the moral advantages which here surround them. If we cannot boast a climate of perpetual spring, we are at least free from the noxious and pestilential vapors of an exuberant vegetation. The rude winds of the North may not greet the poet's ear with half the sweetness of the balmy zephyrs of the West, but they breathe no deceitful influence. They come not to captivate with mild perfumes, and the poison of death lurking beneath; but they sweep boldly and fearlessly over the land, bearing nothing but vigor in their train; tinging the cheek with the ruddy glow of health, strengthening the nerves, and bracing the sinews of industry, and elevating the whole physical and intellectual condition of man.

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## *Louisville, Cincinnati and Charleston Railroad Company.*

The President and Directors of this company met in the city of Lexington on the 27th of August. Present,

Robert Y. Hayne, President.

### DIRECTORS.

*From Kentucky.*—Robert Wickliffe, Gen. James Taylor, Dr. Richardson and J. B. Casey, Esq.

*From North-Carolina.*—Dr. Hardy and Charles Baring, Esq.

*From Tennessee.*—Judge Reese and V. W. Humes, Esq.

*From South-Carolina.*—M. King, B. T. Elmore, Col. R. G. Mills and Dr. Dunnovant.

The President made a full report of all the measures to be adopted for the prosecution of the work since the last general meeting of the Board, from which it appeared,

That Banking privileges had been conferred upon the Company by the States of North and South-Carolina and Tennessee; and that measures had been adopted for putting the bank into operation early in the winter; that the State of South-Carolina had subscribed *a million of dollars* to the Road, and had guaranteed a loan of two millions more, to effect which, Gen. James Hamilton had proceeded to Europe; that Tennessee had subscribed $650,000 to the Road, and that the amount of public and private subscriptions exceed eight millions of dollars, including two millions taken by the Stockholders in the Charleston and Hamburg Railroad, according to the terms of the contract with that Company. It further appeared, that in conformity with the directions of the Stockholders, at their last general meeting, the Charleston and Hamburg Railroad (extending from Charleston to Augusta in Georgia, a distance of 136 miles) had been purchased, and was in a course of rapid improvement—the Road in its entire extent (with the exception of a few miles, which will shortly be finished,) having been *embanked*, and a new and improved iron having been already laid down for upwards of 100 miles, and the balance of the new iron having been ordered from Europe. It appeared, that although these extensive improvements had necessarily been made at an expense considerably exceeding the present receipts, yet that the business and income of the Road were very large, and constantly increasing. The receipts exceed *one thousand dollars per day*, and the travelling, on an average, exceeding *one hundred passengers daily*. The following Table was exhibited, giving a comparative statement of the business and receipts from the time the Road went into operation up to the 1st July last; from which it will be seen that the business of the last half year, has been greater than at any former period:

Statement of the income of the Charleston Railroad, and of the number of passengers, and bales of cotton transported thereon, with the amount of the receipts on account of passengers, and freight and the mail.

| | No. of passengers. | Am't of passage. | Am't of freight. |
|---|---|---|---|
| In 1834, | 26,649 | 79,050 | 83,214 |
| In 1835, | 34,283 | 109,576 | 131,782 |
| In 1836, | 39,216 | 129,982 | 140,033 |
| In 1837, | 41,554 | 131,282 | 138,269 |
| 1st half of 1838, | 23,618 | 80,548 | 78,046 |
| Do. 1837, | 22,506 | 71,202 | 45,581 |

| | Mails, etc. | Total. | Bales of cotton. |
|---|---|---|---|
| In 1834, | 4,294 | 166,559 | 24,567 |
| In 1835, | 8,374 | 249,753 | 34,760 |
| In 1836, | 1,597 | 271,613 | 28,497 |
| In 1837, | 10,663 | 280,214 | 34,395 |
| 1st half of 1838, | 5,541 | 164,231 | 17,872 |
| Do. 1837, | 5,294 | 122,077 | 6,220 |

It further appeared that the main track of the Charleston and Ohio Road, leading towards the Mountains had been laid off, from a point on the Charleston and Hamburg Road, 62 miles from Charleston to Columbia, the capital of the State, 65 miles further ; and that contracts had been made for the execution of the work, which was going on rapidly and successfully. Surveys have been executed along the whole line from Charleston to Lexington, and it had been ascertained that the Mountains can be passed with locomotive engines, at grades less than had been adopted on other Roads; and that no serious obstacles were presented to the construction of the work on any part of the line.

A report was made by Major M'Kee, the resident Engineer, accompanied by maps and profiles, showing the result of the survey on the several lines from Knoxville to Lexington, by Cumberland and Wheeler's Gaps. Among the important facts disclosed in this report, is the discovery of a new pass, by what is called Big Creek, (near Wheeler's Gap,) which promises to afford a ready passage across the Cumberland Mountains, without the use of inclined planes of stationary engines. This Gap has been ordered to be more accurately surveyed.

On a memorial from the subscribers in the neighbourhood of Covington and Newport, setting forth that, in consequence of the alteration in the charter, by which the Company is relieved from making the branch extending from Lexington to the Ohio river, in the direction of Cincinnati, they had determined to apply their funds at the proper time, to the making of that branch, for which purpose charters had been obtained, it was

Resolved, That these Stockholders should be permitted to withdraw their funds accordingly, which having been originally subscribed for that object, could not justly be devoted to other purposes.

A committee was appointed, consisting of Messrs. King, Wickliffe and Taylor, to enquire and report on the state of the funds of the Company in Kentucky, and the measures now proper to be adopted by them in this State, and we subjoin the following extracts from their report and resolutions, which were unanimously adopted.

From the report of the Resident Engineer, read by him to the Board, and submitted to the Committee, and the minute explanations given by him of the maps and profiles of the several surveys from Knoxville to

Lexington, it is manifest that a safe and practicable route exists for a railroad from Knoxville to Lexington. The present situation of the Company, and the yet unfinished state of part of the surveys, should prevent the Board, at this time, either from adopting themselves a permanent location of this Road, or from recommending such a measure to the approaching meeting of the Stockholders. But it is a most cheering fact, and ought to animate them in their arduous undertaking, that every one of the main routes surveyed is practicable, and affords a location for the Road, at an expense far within the means of the States through whose territories the portions of it will pass. The Company will persevere, and they look forward with confidence to the assistance of those States, for the completion of the Road within their limits. Under the existing regulations of the Company, every cent contributed by the States respectively, will be devoted to the erection of the Road within their several boundaries, until it be there completed. So that, as your Committee confidently believe, in no event that can occur, can their citizens fail to be benefitted by their assistance, to its full extent: and your Committee sanguinely hope that the time may speedily arrive, when a continuous railroad from Lexington to Charleston, will give to Kentucky the full benefit of a direct, speedy, and economical connexion with the Atlantic, and all the advantages of an excellent seaport for her growing and highly valuable commerce—where she can find a steady, ready, and good market for all her rich products, and for all those supplies required by her industrious, affluent, and enlightened population. She has but to will it, and it shall be accomplished. Your Committee cannot doubt that she will consult her true interests and her own honor, and come up with her own high spirit and unfailing enterprise to aid in this grand work, and entitle herself to the lasting gratitude of all her children.

Until Kentucky does make an efficient move in this matter, your Committee can neither flatter themselves nor the Board with the expectation that any successful progress in it can be made within her limits. She must set an example to her citizens, before they can be induced to engage in it with the zeal and determination which its great importance deserves. Your Committee believe that, were she to ratify the banking privileges that have recently been granted by the three other States, through whose territory the Road is to pass, that ratification would go far to secure to her the benefit of the Road, and as your Committee are convinced, she may render that benefit certain, by joining the two of her sister States, who have so nobly and liberally contributed to the funds for erecting the Road, and will hold shares in it proportionably to the amount subscribed by them.

2d Resolution, That the County Court of Fayette, and the individual subscribers in Kentucky, be invited to pay the last instalment on the stock subscribed by them; and that they be assured that every cent heretofore paid by them has been faithfully and exclusively employed towards the defraying of the expenses of explorations and surveys within this State, and all that may be hereafter paid by them on their subscriptions, shall be expended within the State of Kentucky, until the road be completed.

5th Resolution, That a survey as recommended by the Resident Engineer in his report, be made of the Gap across the Cumberland Mountain, to the eastward of Wheeler's Gap, that ascends on the one side by Indian or Big Creek, and descends on the other by Davis's Creek; and that the expenses of this survey defrayed from the funds raised in the State in which the pass is situated.

6th Resolution, That an application be made to the Legislature of Kentucky, at their next session, for their concurrence in the act granting Banking privileges to the company, and for such further aid as they may think proper to extend to our enterprise, and that the President of the company be requested to attend the Legislature, to urge this application, if he can attend consistently with the interests ot the company.

The following resolution, offered by Mr. Wickliffe, was also adopted, viz. :—

Whereas it appears from the report of the Resident Engineer, that further surveys are necessary, to enable the Board of Directors to locate the Road from the city of Lexington, through the county of Fayette, to the Kentucky River.

Resolved, That the whole of the funds to be raised by the county, shall be applied, first, to the surveys, location and construction of the Road, and the *depot*, in the county of Fayette, as aforesaid.

After transacting much other business, the following resolution, offered by Judge Reese, was unanimousty adopted ; after which the Board adjourned to meet at Ashville, N. C. on the 17th of September.

Resolved, That the measures adopted since the opening of the General Board at Flat Rock, in October last, (as reported by the President,) be, and they are hereby approved of and confirmed ; and the President be and he is hereby authorized, to adopt such measures as may be necessary to carry the same into full effect ; and that a committee, to consist of the Directors residing in Charleston, and of those residing in Columbia and its vicinity, be, and are hereby appointed, to consult with, and advise the President as to the further measures to be adopted, to complete the repairs and improvements of the Charleston and Hamburgh Road—to provide the means for paying for the same, and for such an organization thereof as they may deem desirable, with authority to borrow money on the credit of the Company, and to call for another instalment when necessary ; that the works now in progress be prosecuted to the extent of the means at the disposal of the Company ; and that all the necessary appropriations be, and they are hereby made.

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(Continued from page 129.)

## *Minutes and Proceedings of the Institution of Civil Engineers, containing Abstracts of Papers, and of Conversations for the Sessions of 1837.*

### May 23, 1837.

The President in the Chair.

The paper by Mr. G. H. Palmer, commenced at the last meeting, having been concluded, a discussion took place on the duties of Engines. The question was asked, whether the water raised had been actually measured, and whether the calculations were not made from the known contents of the working barrel. It was the opinion of several present that the duties had always been ascertained in the latter manner. An engine in which the Cornish system is adopted, near London, has a duty of fifty millions, and the Cornish system of clothing was considered as effecting a very considerable saving in fuel.

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"Account of some Blasting operations through the white Limestone on the Antrim Coast Road, in the north of Ireland ; by William Bald, Civil Engineer, M.R.I.A., F.R.S."

In the commencement of the paper, the nature of the Antrim Coast and of the white limestone, and the method of blasting, are briefly described. This limestone is similar to the chalk of England in the flints which it contains, but it is exceedingly indurated. From the results of the blasting of several large masses of rock, it appears that *one* ounce of powder will rend 14·12 cubic feet of this limestone when in blocks; whereas the same quantity of powder was required for 11·75 cubic feet of loose whinstone blocks. The specific gravity of the white limestone is very nearly 2·760, and of whinstone or basalt about 3·200. The induration of white limestone may be estimated from the fact, that two men will bore *one* foot deep in half an hour, the diameter of the augers or jumpers being from $1\frac{5}{8}$ to 2 inches.

A table is given exhibiting the diameter of the auger or jumper used, and the number of inches of gunpowder put in—*one* pound of gunpowder occupies *thirty* cubic inches. The force of the explosion of gunpowder is assumed to be as the cube of the line of least resistance; if the *one* ounce of gunpowder will open a distance of 1 foot of rock, 2 feet would require 8 oz., and 10 feet 1000 oz. There will be some difficulty in ascertaining the line of least resistance in stratified rocks, since the rock may be fissured, or some bed or opening may lie near to the line bored; but the hypogene rocks, as granite and sienite, lying in compact unstratified masses, present no such difficulty.

The paper is accompanied by drawings and sections, and showing the mode pursued in blasting down high cliffs, by boring at the *toe* of the rock; the peculiar character of the veins commonly called scull veins, from their strong resemblance to the satures of the scull, which traverse the blocks of white limestone: and concludes by expressing the importance of collecting accounts of the quantity of gunpowder consumed per cubic yard in blasting the various kinds of granite, sandstone, &c.; also the diameter of the augers or jumpers; the depths bored, and the quantity of gunpowder the most effective.

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May 30, 1837.

The President in the Chair.

"On the results obtained by Mr. G. H. Palmer, respecting the Maximum Duty of a given quantity of Atmospheric Steam; by Thomas Webster, M.A., Sec. Inst. C. E."

The object of this paper was to show, that the result obtained by Mr Palmer, in his paper on Steam, read at the two previous meetings of the Institution, coincides very accurately with the authenticated accounts of the best Watt engines. In the calculation made by Mr. Palmer, no account is taken of the heat rescued by employing over again the hot water. This, considering the relative quantities of latent and sensible caloric in steam, may be taken at one sixth; and being taken into the account, we may consider that, on the principles laid down by Mr. Palmer, the duty done by a Watt engine ought to be about thirty-two millions.

The next question is, what amount of saving is to be attributed to the system of clothing adopted in the Cornish engines. This it is stated may change the data entirely; the quantity of water evaporated may be very different: the quantity of heat saved and worked over again incalculable; at present then we cannot apply any principles of theoretical calculation to this case.

"Further Observations on Blasting the white Limestone of Antrim Coast, by William Bald, Civil Engineer, F. R. I. A."

These further observations are directed more especially to the principle assumed by Mr. Bald in his previous communication, that the force of the explosion of gunpowder is as the cube of the length of the line of least resistance. This is the law which Vauban and Belidor have been led to assume as the result of their investigations, and Mr. Bald proceeds to show that his experiments confirm it. It appears from the experiments there detailed, that 1·9 oz. was required for the smaller blocks, and 2 oz. for the larger, per cubic yard. Knowing then the quantity of gunpowder used, and the solid contents of the blocks, we have only to extract the cube root of the cubical contents of their respective masses. Taking then the length of the line of least resistance in each of these cubes to be equal to the distance from the centre to the nearest point on the surface, we know from the preceding calculation the lengths of these lines, and it appears that these experiments confirm the law of the explosive power of gunpowder, being as the cube of the line of least resistance.

The paper concludes with remarks on the purposes for which this limestone is adapted, and on the ravages to which all calcareous rocks are subject from the Pholas Dactylus, and is illustrated by drawings of the forms, fissure of the limestone, and of the beautifully radiated and fluted shell of the Pholas. From the curves traced by nature in this shell, the engineer may learn the best shape to be given to the slopes of breakwaters and harbours exposed to the ocean.

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"On Warming and Ventilating; by James Horne, F.R.S., A. Inst. C.E."

In this paper the author describes a method of warming and ventilating, on the principle of spontaneous ventilation, by means of an iron stove, care being taken that the *quality* of the air is not affected by the iron plates exceeding a certain temperature; and mentions a successful attempt to warm and ventilate a chapel on the same plan.

Mr. Horne gives also an account of a method which he had adopted to ventilate an extensive drift or level, by forcing in air. The machine, a drawing of which, with all the details and dimensions, is annexed, consists of an upper cylinder, inverted, and working in a lower cylinder nearly full of water. An attempt was first made to ventilate by drawing out the foul air; this, however, did not succeed The level is 7 feet high, and 4 feet 6 inches wide, and driven a mile before a rise into an upper level; the rise was then put up 400 feet in height; both level and rise were ventilated successfully by this apparatus. The diameter of the ventilating pipe was 5 inches, its length a mile. This showed most satisfactorily that ventilation could be effected by forcing in air through a great length of pipe.

Some conversation took place on the power expended in producing this ventilation, and on the friction of air forced through pipes; and reference was made to several cases which seemed to show that air could not be forced with effect through a great length of pipe, as for the purpose of blowing blast furnaces, whereas some experiments seemed to show that air could be forced through small pipes of 50, 100, or 150, in length, with the same velocity under a given pressure.

Mr. G. H. Palmer stated, that if 100 cubic feet of air could be forced through a small hole under a pressure of one inch of water in a given time, only 25 cubic feet would be delivered under the same pressure through a pipe 1000 feet in length in the same time.

Mr. Hawkins stated, that in the old Thames Tunnel a two-inch pipe had been found quite insufficient for ventilation at a distance of 400 feet, but that a three-inch from the same bellows, and under the same pressure, had been quite sufficient. In the former case it was suggested that the friction of the pipe was nearly the same as the pressure in the bellows, so that the air was simply condensed.

Several other instances and experiments were quoted, and it appears that we must often consider whether the condensation has had to time to take effect. The air may be condensed rapidly and none forced out, but if the operation takes place slowly, the condensation will have time to take effect.

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## *South Carolina Railroad.*

A report of the South Carolina Railroad, leading from Charleston to Hamburgh, during the first six months of the present year, has just been published. The income during the six months amounted to $164,231, the whole of which has been exhausted in expenses, and improvements in the machinery, so that no dividend can be made. There has been a gradual increase of income each year since the opening of the road.

Two great improvements have been for a long time in progress, and one of them is nearly completed. One of these improvements is the substitution of an embankment, for the support of the rails, on the decay of the timber on which they were originally supported. This is all completed, with the exception of about five miles in extent, which is under contract to be finished in October next. Before covering the wood work with the embankment, it has been completely repaired, The other improvement is the substitution of a heavier iron, for that which was originally laid down. Considerable progress has been made in this change, and the new iron is wanting on only 45 or 46 miles. Where the new iron has been laid, the expense of the repairs is much diminished.

In conformity with an arrangement made in January last, nearly all the stock, viz. 19,217 shares out of 20,000 has been sold to the Cincinnati and Charleston railroad, and the stock transferred. The other proprietors have not refused to sell, but accidental circumstances have prevented the transfer. The directors recommend an increase of the rates of toll for passengers and freight.

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*The Welland Canal.*—You are perhaps aware that there have been great complaints against this canal, and that its expense is far greater than its income—that it is often out of repair, &c., and fears are entertained that in time it will be altogether unfit for use, unless something be immediately done to the locks &c. When the Earl of Durham visited the upper province, care was taken to make him acquainted with the whole matter; he saw at once its importance, and authorized such improvements as will ensure the navigation of this important link between Lakes Erie and Ontario, upon a much enlarged scale. The locks, which are now of wood, are to be of cut stone. It now requires forty-one locks to reach the summit levels—underthe new arrangement twenty-one only will be necessary. They are to be twenty-six feet wide, and one hundred and twenty feet long.

At Port Dalhousie, the outlet into Lake Ontario, there will be a capacious basin for steamboats and other craft, which will be entered by two locks, to be forty-five feet wide and two-hundred feet long. This basin will probably be protected by a fortification, which can easily be constructed; and should it be deemed expedient, it can be made a strong hold. The entire length of this canal will be 28 miles and a few chains. I understand from the chief engineer that the whole of the mason work will be completed without stopping the navigation for a moment, as the new locks will be built at some distance from the present site.

Thus in three years the whole line will be completed according to the new plan. At present the canal is said to be doing a good business, but when the improvements are completed, a large increase is expected. There will be no want of funds. The commissioners on the part of the government are Col. McAuley, Dr. Joseph Hamilton, and the Hon. John Wilson, formerly Speaker of the Assembly—on the part of the stockholders, Hamilton Merritt, Esq. and Colonel Creighton.

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*The Nashville Railroad* offers many attractions to visitors. The cars travel out now a distance of twelve miles, where the road meets the Lake —at that point a house is building designed for a hotel, which will soon be ready for the entertainment of guests—by the first of September it is expected that a few rooms will be ready for use. From the site of this establishment a wide and noble prospect opens—on one side the lake expands its blue surface, stretching as far as the eye can reach, with here and there a sail gliding upon its bosom; while on the other an extensive prairie spreads around for miles, covered with tall luxuriant grass, presenting to the eye a sea of verdure in contrast with the liquid plain, that meets the view in the opposite direction. The scenery along the whole route after leaving the city is highly interesting, and at many points picturesque and imposing. The sight of the prairies alone, would more than compensate the trouble of a visit. The vicinity of New-Orleans furnishes no *ride* into the country, in which may be enjoyed such an enchanting variety of agreeable and entertaining objects. The mechanism of the drawbridge over which the steam cars cross the canal, is particularly worthy of notice. By the use of a stationary steam engine, the bridge is moved into its connexion with the rail-way in 30 seconds, so that the whole work of drawing and withdrawing the bridge may be done in one minute. Before the skilful machinist, Mr. Tayler, resorted to the application of steam, an hour was sometimes spent in making the same movement by hand—this improvement must be a great saving of time and labor. The rapid progress the company is making in the construction of the road is astonishing. Under the management of the enterprising President, Mr. Caldwell, and the able and accompliched engineer, Mr. Hord, every thing seems to *go ahead*. The rail track is advancing now at the rate of two miles per month. By the first or fifteenth of November it is expected that cars will travel to the plantation of Mr. Labranche—a distance of twenty miles from the city; and on the first of March, the road will be completed to Pass Mauchac. So soon as this point is reached, the railway will begin to bring in a large revenue to the Company, as it will be used as the thoroughfare for all the produce and commerce of Lake Maurepas, and the adjacent country.

Immense quantities of lumber and firewood will come from that quarter, and extensive supplies of marketing, in the shape of vegetables, poultry, fruit, milk, game, &c. The grant of the last legislature will be sufficient to carry the road that far. The brilliant success and obvious advantages of that scheme must, no doubt, lead to more liberal appropriations, till at length a general enthusiasm shall seize upon the country; when every man convinced of the importance of the enterprise, will put his shoulder to the wheels, and push our rail cars *with a rush* to Nashville. To bring about this desirable state of popular feeling, nothing more is necessary than to study and comprehend to the real extent, the facilities and benefits that must accrue to New Orleans from the structure of this great highway. Should every housekeeper in the city make a present of $500 to the Company, he would in twelve months after the completion of the road, find himself more than compensated in the cheapness and plenty with which the necessaries of life could be obtained, and the numberless conveniences and luxuries that were brought within his reach. Already the public mind begins to be enlightened on the subject, and the way the undertaking promises to progress is rapid and flourishing.—*N. O. Bulletin.*

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*The Great Bridge.*—The magnificent Railroad Bridge over the James River, which we noticed in the course of the last week, was opened on Wednesday night, for the transportation of the cars. Yesterday, the cars from Petersburgh passed over to the Depot on this side, within a few yards of the Bridge—and after 10 o'clock, two other cars passed over from the Richmond side to the Manchester side; the first with the passengers who had just arrived in the Northern Car—and the other contained several ladies and gentlemen, who were willing to try the experiment of passing over the river on this air built Bridge. The cars glided over with the greatest ease—presenting the most beautiful views of the surrounding landscape to the delighted passengers. We understand the Railroad too has already been encouraged beyond calculation—and that it is likely to prove a source of considerable profit to the proprietors, by the contribution of the passengers alone. But the completion of the Depot is calculated to invite the transportation of produce. At present, the cars will pass two and fro, twice in the 24 hours—besides an extra car in the course of the week. We confess we take a deep interest in a company, which has thrown over the James River, the noblest Bridge in North America.—*Richmond Enq.*

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*The Bridge of Cabzag.*—A remarkable bridge is now considerably advanced in France, which will be one of the most remarkable structures of the kind in the world. It is a suspension bridge, of five arches or spans, each of which is 300 feet in width. The floor will be 70 feet above the surface of the water. The suspension chains will be supported by columns of cast-iron 90 feet in height, resting on pedestals of masonry.

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*American Locomotives.*—The U. S. Gazette states that Mr. Norris last week shipped a second locomotive engine from Philadelphia for Austria, to be used on the long railroad extending to Wagram. It is expected that two more will be made for the same destination. This circumstance is highly creditable to American mechanics, and evinces the estimation in which our skill and enterprise are held in Europe.

AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

No. 8, Vol. I.
New Series.] OCTOBER 15, 1838. [Whole No. 272
Vol. VII.

## Power of Traction of Locomotive Engines.

MESSRS. MINOR & SCHAEFFER:—

I have just observed, on my return to this city, after an absence of several weeks, a communication in the Railroad Journal, from C. E. Detmold, Civil Engineer, commenting upon the letter of Mr. Talcott, and also upon my remarks accompanying the same, in the first number (new series) of the Railroad Journal.

Mr. Detmold says, in respect to an error in the loads for the two lower velocities in the table to which he refers, that instead of attributing it to the circumstance of "having employed the formula of De Pambour beyond its proper limits," I have "ascribed it to the inaccuracy of the formula;" and he supports this allegation by quoting from my remarks where I say, that "the formula of De Pambour gives, under a continued decrease of velocity, a continued increase of power, and does not therefore designate the point at which it ceases to be applicable."

In this remark the fact is certainly most clearly and distinctly set forth, that there is a "proper limit" to the application of the formula, or, as I have expressed it, "a point beyond which it ceases to be applicable." I state further, and this is all I do state in reference to the character of the formula, in respect to its bearing upon the error in question, that "this point is not designated" in the formula. This is strictly true, and is so acknowledged by De Pambour, as appears in the quotation from him taken from the same paragraph of Mr. Detmold's communication with the above, where he says, that "beyond that point (alluding to the point where the power and the resistance equilibrate on the piston) the equation *may continue to give results*" which, however, will no longer be correct.

It certainly was not my intention, and in no part of my remarks can I discover that I have ascribed the error referred to, to the "errors and inaccuracies of De Pambour," as asserted by Mr. Detmold; on the contrary, I distinctly attributed it to inadvertence, resulting from the "haste" in which the table was prepared, combined with the circumstance that the formula "does not designate the point at which it ceases to be applicable," a circumstance which has probably led De Pambour himself, in at least one instance, into precisely the same error, as will appear by reference to his "practical table," p. 186;* where the resistance presented by the load, when referred to the pistons, is greater than the maximum effective pressure of the steam on the same pistons.

* Philadelphia Edition

That there may be no misapprehension, I wish it distinctly to be understood, that this case, and any others to which I may have occasion to refer, are not alluded to with the view of disparaging the labors, or detracting in the least from the great credit due to De Pambour for his very valuable experiments, and analysis of the powers and properties of the Locomotive Steam Engine. This credit is fully awarded to him in my letter, and in my remarks, and I am compelled to say that Mr. Detmold in his "too great haste" to shield the reputation of De Pambour in a point where it was not intended to be assailed, or even threatened by me, has done me, as I conceive, an injustice.

That exceptions, such as are urged by Mr. Detmold, may not be taken to a portion of Mr. Talcott's remarks, I do not pretend to affirm or to deny. For his views upon the subject and mode of illustration, I am not responsible—Mr. Talcott is fully able in this matter to speak for himself.

I stated in my letter, while commenting upon the *general character* of the formula of De Pambour, that there were "inaccuracies in the mode of conducting and analyzing his experiments." This statement was made before the error above referred to, in the table, was observed, and had therefore no reference to it.

In my remarks, accompanying Mr. Talcott's letter, I repeated the above statement, saying, that "on a more critical examination, those defects were greater than I at first anticipated." Some of those defects I will now briefly describe.

De Pambour informs us, p. 49, that the spring balance for determining the pressure of the steam in the boiler, is the same as that commonly used for weighing, being constructed upon the same principles, and graduated in a similar manner. The parts of which the balance are composed may be designated as follows:—*

| | | | | |
|---|---|---|---|---|
| 1. | Weight of the spring, | represented by | | S |
| 2. | " | Rod, nut and index, | " | T |
| 3. | " | Plate, tube and foot, | " | P |

When the balance is in the proper position for weighing, with no weight attached, and supported by the nut, the force compressing the spring is P+S. In this situation the index is at zero; when, therefore, the balance is attached to the boiler, the lever before it can compress the spring, must overcome the weight of the rod, nut, and index, equal to T. To this must be added the force as above, P+S, necessary to compress the spring, making the whole force exerted by the lever, in sustaining the index at zero, the point at which it begins to register any effort —equal to P+T+S, or equal to the whole weight of the balance, and this, therefore, is the correction to be added to the amount pointed out by the index. This may be explained in a different manner, as follows:— The lifting effect of the foot of the balance upon the boiler is precisely equal to the weight pointed out by the index. The lever, by its upward action, exerts a force equal to this, and in addition thereto, supports the whole weight of the balance, since no portion of the latter rests upon, or is supported by, the boiler.

In the example, p. 53 and 68, where the weight of the balance is 4lbs., the

* The parts composing the spring balance may be variously arranged. The force applied may either expand or contract the spring, or the plate and tube may be attached to the rod instead of the foot, or the index may be attached to either the rod or the foot. I have adopted the arrangement in the balance used by De Pambour, as near as the same could be ascertained from his description.

correction is 4lbs. De Pambour makes it $2\frac{3}{4}$lbs. If the balance is "turned upside down," as in the case of the Vesta Engine, p. 71, the correction becomes then equal to 2P+S. The value of S not being known, the true correction, in this case, cannot be ascertained; enough, however, is known to show that in both cases it is nearly 50 per cent. greater than the amount obtained by De Pambour.

The true correction being thus ascertained and applied, and the proper allowance made for the effect of leverage, and weight of lever and disc, &c. the total pressure of the steam in the boiler is found to be a little greater by the spring balance than by the mercurial gauge.

There is another correction, not noticed by De Pambour, resulting from the conical shape of the valve, by which the surface exposed to atmospheric pressure, is greater than that exposed to the pressure of the steam.

In this case, the correction is equal to the atmospheric pressure upon the difference of the two surfaces divided by the area of the lesser one. If the diameters of the two surfaces of the valve are represented by D and *d* respectively, the correction is equal to

$$\frac{\cdot 7854\,(D^2 - d^2)\;14\cdot 7}{\cdot 7854\,d^2} = \left(\frac{D^2}{d^2} - 1\right) 14\cdot 7.$$

Supposing D = 3 inches, and $d = 2\frac{1}{2}$ inches, as per page 5, the correction per square inch amounts to 6·47lbs., adding to this the error in the correction of the spring balance, as above explained, and the total *effective* pressure in the boiler will be found to be about $7\frac{3}{4}$ lbs. greater than is computed by De Pambour; equal to about 14 per cent., supposing the average effective pressure in his experiments to be as high as 55lbs. per square inch.

The allowance for excess of atmospheric pressure upon the upper surface of the valve, proceeds upon the supposition that the valve is fitted closely to its seat. This closeness of fit may not exist practically, and hence the difference in the surfaces sustaining the opposite pressures may be less than is supposed above, thereby reducing the amount somewhat from the estimate. The exact amount proper to be allowed can only be ascertained by experiment.

The corrections, as applied by De Pambour to the spring balance, exhibit the effective pressure equal very nearly to that obtained by the mercurial gauge. That the pressure obtained by the latter was *too low*, is evident from the statement of his, p. 77, where he says "that the steam necessarily cools in the long passage from the Engine to the instrument, being forced to follow a metallic tube 8 or 10 feet long, by half an inch in diameter, and must consequently arrive on the mercury with a *less degree of pressure than in the boiler.*" Hence it follows, that the pressure obtained by the spring balance as corrected, was also *too low*, the results being nearly the same in both cases.

The conclusion drawn from the above, is, that the spring balance, even when applied in the usual way, is a more accurate test of the actual pressure in the boiler (when the corrections are properly made) than the mercurial gauge. There is still, however, room for much improvement in the former instrument. The plan proposed by De Pambour, p. 76, is not, I conceive, the best for accomplishing the object. To arrive at the true pressure, it appears to me necessary to avoid the conical shape of the valve, and the blowing of the steam. To effect this, the valve must be set aside, or appropriated exclusively to its more legitimate use, viz., the emission of the surplus steam, and the spring balance applied to a cylindrical piston having a known diameter. The lever not being essential, may be dispensed with, unless perhaps it is introduced to magnify the divisions on the graduated scale, and the cylindrical piston allowed to act directly against the spring of the balance, care being taken to inter pose some non-conducting substance, so that the spring shall not come in so close contact with the boiler as to have its elasticity affected by the heat. The contraction or expansion of the spring, as shown by an index upon a scale previously graduated by the application of known weights or pressures, will give the actual pressure without any correction. An instrument constructed in this manner, will possess the peculiar advantage of showing the pressure at all times, whether that pressure is *greater* or *less* than the resistance opposed by the valve.

It will readily be seen that the valve, as ordinarily constructed, affords but an unsatisfactory indication of the actual elastic force, or pressure of the steam, particularly in those cases where, for the purpose of experiment, it is desirable to maintain the force of the steam at a given point. When the steam is blowing from the valve, it is evident that its elastic force *exceeds* the resistance presented by the valve, but how much it exceeds, although perhaps a tolerably correct judgment may be formed, cannot be correctly ascertained. When the force of the steam is insufficient to raise the valve from its seat, and there is no blowing, all that is known with certainty, so long as the resistance of the valve continues unchanged, is, that the elastic force of the steam is *less* than the resistance of the valve. How much less cannot be precisely told.

As the exact measure of the pressure of the steam lies at the foundation of a correct analysis of the powers of the Locomotive Engine, all deductions from experiments made under an erroneous measurement of the pressure must be "defective;" and hence, the importance of examining closely the mode of "conducting and analyzing" the experiments on this branch of the subject.

There is another point, and it is the only one which I propose to notice at the present time, in which there is evidently a defect in the formula of De Pambour. That formula, even "within the limits in which it is properly applicable," assumes as constant and invariable, one of its chief elements which possesses an opposite character. I allude now to the value of S, the effective evaporating power of the Engine in cubic feet per hour.

Owing to the manner in which the blast is produced in a locomotive Engine, by discharging the waste steam into the smoke pipe, it follows that the blast is increased, and consequently (the kind and quality of the fuel remaining the same) the evaporating power of the Engine is also increased under an increase of speed.

Hence it is, that although the formula of De Pambour may give results with tolerable correctness for those velocities and pressures corresponding with the mean velocities and pressures derived from the experiments, yet in proportion as there is a departure from those velocities, there will be a deviation from the truth in the results. In consequence of these deviations, the absolute power of the Engine is greater for the higher velocities and less for the lower than is indicated by the formula. The experiments of De Pambour do not enable us to ascertain with certainty the increase in the evaporation, and consequent augmentation of power, compared with the increase in the velocity. That it is considerable, is evident from the table of experiments, p. 154, where it appears that the *effective* evaporation per hour in the Atlas Engine was for a speed of fifteen miles per hour 36·23 cubic feet, and at 8·99 miles per hour only 30·19 cubic feet.

The average effective pressure of steam in the boiler being in the first case 53·7 lbs. and in the latter 53 lbs per square inch, a difference too small to have any sensible influence upon the evaporation.—Hence the difference in the evaporation must be attributable mainly to the difference in the velocity. This great difference in the evaporation amounting, in the present instance, to 20 per cent. more at 15 than at 8·99 miles per hour, is not recognized in the formula of De Pambour,—the quantity S, representing it, being there assumed as constant at all velocities. When, therefore, we consider that under an increase of velocity beyond the 15 miles mentioned in the experiment, the difference in the evaporating power will be increased in a still greater degree than is above stated, it is obvious that a formula which does not recognize so great a difference must be "defective."

This difference in the evaporating power, under different velocities, is farther shown in the cases of the Firefly and Leeds Engines, in the table above referred to: the first evaporating 44·23 cubic feet at a speed of 17·70 miles per hour, and 52·40 cubic feet at a speed of 21·33 miles, and the latter evaporating 45·39 cubic feet, at a speed of 18·63 miles, and 47·56 cubic feet at a speed of 21·99 miles per hour—the difference in the pressure being in both cases, as in the preceding one, too small to affect sensibly the evaporation.

The two experiments recorded in the same table, made with the Fury Engine, are an exception to the above; but there evidently is one, if not both, of them erroneous, since upon the same day, under the same pressure, with less speed, and less load, the evaporation in one case is 6 per cent *greater* than in the other, instead of being *less*, as it evidently should be.

Unfortunately, the experiments upon this very important branch of the subject by De Pambour are few in number, and insufficient to determine with certainty the law of increase of evaporation under an increase of velocity. Enough, however, can be gathered to show, that in framing a formula applicable to different velocities, the difference in the evaporating power cannot, as is done by De Pambour, be safely neglected.

The *effective* evaporating power stated above, as obtained by experiment, is the total amount of water consumed in each case, as per the table referred to, less by its one-fourth part—that being the proportion *assumed* by De Pambour as proper to be deducted for waste by leakage and escape of surplus steam, &c. Whether there is on the average, this large per centage of waste in all, or in a majority, of the recently constructed and more improved Engines, may, perhaps, be doubted. So large an amount *arbitrarily* thrown away in all conditions of the Engine, must, when there is any great difference in condition,* produce a corresponding difference

* It should be borne in mind, that the *assumption* of an *average* loss, in all conditions of an Engine, by leakage, escape of surplus steam, &c. of one-fourth or 25 per cent., is an acknowledgement that the *actual* loss is as much and as often *greater* as *less* than that amount. Instead of there being all this great loss by leakage, &c. it may yet perhaps be found that the total resistance on the piston, and, consequently, the actual pressure of the steam in the cylinders, has not been correctly ascertained. The force of reaction of the steam, while effecting its escape from the cylinder, is, I apprehend, of more consequence than has generally been supposed. This force, forming as it does part of the value of R, or the resistance to be overcome by the pressure of the steam, cannot, in arriving at a correct expression of the conditions under which the two opposing forces equilibrate on the piston, be with propriety omitted. This resistance is not embraced in De Pambour's analysis, and his experiments do not afford the means of ascertaining its amount. De Pambour did not, if I recollect rightly, determine the relation between the actual distance passed over by

in the estimate of its power. That this difference is great, there is reason to infer from a comparison of the *effective* evaporating power of the Vulcan and Leeds Engine,(experiment 2d) in the table referred to. These two Engines running nearly at the same velocity, (22·99 and 21·99 miles,) drawing nearly equal loads, (39·07 and 37·51 tons,) with nearly the same effective pressure, (54½° and 49°,) having nearly the same amount of heating surface, (136 and 137 square feet,) the surface exposed to the radiating heat bearing the same ratio to that exposed to the communicative heat, in the one case as in the other, viz: 10 per cent.; yet the former, notwithstanding this near approach to equality in all the attendant circumstances, appears to have evaporated 10 per cent. less per hour than the latter—the *total* evaporation in the former case being 57·92, and in the latter 63·41 cubic feet. So also in the cases of the first experiment of the Leeds and Fury Engines, where there is a near approach to equality in the attendant circumstances, the difference is about 15 per cent., which must be mainly accounted for in the difference in the condition of the Engines at the time the experiments were made.

De Pambour, in arriving at the proportion or relation of the heating surface to the evaporation which he has incorporated in his formula, takes the average of the experiments contained in the table above referred to, p. 154. How near the result in each case corresponds with the result by his rule, *deduced from the same experiments*, the following table will show:—

| No. | Name of Engine. | Velocity in miles per hour. | Av. Effective pressure in lbs. per sq. in. in Boiler. | Effective evapora. power in cub. ft. per hour. By Experiment. | Effective evapora. power in cub. ft. per hour. By De Pambour's Rule. | Dif. cub. ft. | Per centage difference |
|---|---|---|---|---|---|---|---|
| 1 | Vulcan | 22·99 | 54½ | 43·44 | 40·8 | + 2·64 | + 6 |
| 2 | Atlas | 8·99 | 53·7 | 30·19 | 39·0 | — 8·81 | —29 |
| 3 | do. | 15·00 | 53 | 36·23 | 39·0 | — 2·78 | — 8 |
| 4 | do. | 15·53 | 30 | 34·89 | 39·0 | — 4·11 | —12 |
| 5 | Fury | 19·67 | 57 | 39·02 | 40·2 | — 1·18 | — 3 |
| 6 | do. | 18·63 | 57 | 41·27 | 40·2 | + 1·07 | + 2⅔ |
| 7 | Firefly | 17·70 | 44 | 44·23 | 40·5 | — 3·73 | — 8⅓ |
| 8 | do. | 21·33 | 49 | 52·40 | 40·5 | +11·90 | +23 |
| 9 | Vesta | 27·23 | 51 | 45·75 | 39·3 | + 6·45 | +14 |
| 10 | Leeds | 18·63 | 54 | 45·39 | 41·1 | + 4·29 | + 9½ |
| 11 | do. | 21·99 | 49 | 47·56 | 41·1 | + 6·46 | +13⅔ |

The greatest differences between the experimental results and those obtained by the rule, occur, as would naturally be expected, under the higher and lower velocities: the difference for the minimum velocity, (8·99 miles) being 29 per cent. greater, and for the maximum velocity (27·23 miles) 14 per cent. less than the truth. Precisely, therefore, in the same ratio will the velocities obtained by the formula (other things being equal) differ from the truth in the cases mentioned. Take, for example, the first experiment with the Atlas Engine,—the velocity corres-

the engine, and the distance due to the number of revolutions of the driving wheels. There is reason to believe that under certain conditions of the rails and rates of speed, and amount of load of the engine, the difference is considerable, and may perhaps account *in part* for the great consumption of steam over and above what is due to the number of revolutions as deduced from the distance.

ponding to the maximum load for this Engine, using the expression

$$V=\frac{m\,SD}{d^2 l}$$

and adopting De Pambour's rule for obtaining the value of S, is

$$V=\frac{415\times35\times5}{1^2\times1\frac{1}{3}}=11\cdot49$$

miles per hour. Taking the value of S, as found by experiment, and there results

$$V=\frac{415\times30\cdot19\times5}{1^2\times1\frac{1}{3}}=8\cdot89$$

miles per hour. In like manner the velocity corresponding to the maximum load of the Vesta Engine, instead of being 13·5* miles per hour, as computed by Mr. Detmold under the formula, is probably considerably less than that amount. This is also obvious from the fact, that in the second experiment preceding the one which Mr. Detmold has quoted, and on the same page, the load of this Engine, reduced to a level, under very nearly the same pressure, is only 129 tons, or 60 tons less than the maximum load of 189 tons—the velocity being 12·1 miles per hour, or 1·4 miles per hour less than the computation of Mr. Detmold, showing that at that low rate of motion, the speed was not reduced down to the point corresponding to the maximum load.

The very great importance of arriving at a correct estimate of the evaporating power of an Engine, in determining the velocities for given loads, and vice versa, is evident from an inspection of the general formulæ given by De Pambour for that purpose. Thus, for determining the velocity V, which an Engine of known proportions will take, when working at a given pressure and drawing a given load, the formula is

$$V=\frac{mPSD}{(F+9+M)\,D+pd^2 l}$$

It is unnecessary to repeat here what particular quantities the several letters in this formula represent, any farther than to say that the factor S represents the effective evaporating power in cubic feet per hour. It is obvious that the value of V, the other quantities remaining the same, is precisely proportional to that of S, that is, as S is greater or less, so also will V be greater or less, and in the same ratio.

In determining also the load (M) which an Engine will be able to draw with a known pressure, and at a determined velocity, we have

$$M=\frac{mPSD-pd^2V}{9VD}-\frac{F}{9}$$

In this, as in the preceding case, the quantity S holds a prominent place in the equation, the value of M being greater or less as that of S is increased or diminished, although not in the same proportion.

I have shown, I believe, conclusively, that great discrepancies must unavoidably take place between the actual results, and results obtained by the formula. I am aware that instances may be adduced where there is a near coincidence, but there are many others in which the deviation is so great as to render the formula, in cases where great accuracy is required, of little or no practical use.

* There is a clerical inaccuracy in Mr. Detmold's computation. The true velocity by the formula is a little less than he represents it.

De Pambour remarks with justice, p. 143, that "the power of an Engine resides, at the same time, both in the greater or smaller quantity of steam generated, and in the degree of pressure or elastic force of that steam." I have, I believe, shown that there are defects in his mode of arriving at a correct measure of both these chief elements, defects which exist both in the "mode of conducting and analyzing his experiments."

Having already extended this communication beyond what I intended when I sat down, I will conclude, by repeating the opinions expressed in the remarks which have been the subject of the over-hasty, and may I not with propriety add, somewhat captious criticism of Mr. Detmold, viz., "that the subject of the principles of operation and mode of construction of locomotive Engines is one of great importance. De Pambour has done much, *very much*, towards adding to the stock of knowledge upon the subject. His experiments are valuable, *but they require to be extended and carefully revised.*" E. F. JOHNSON.

New-York City, September, 1838.

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## *Remarks on De Pambour's Formula.*

MESSRS. EDITORS:—The object of my communication, 15th June, published in the third number of your Journal, was to defend the valuable formulæ of De Pambour from the charge of being erroneous and false, which had been indiscriminately pronounced by Mr. W. H. Talcott, and not to enter into a personal discussion. Quibbling and bandying words have never yet drawn a single truth from science, and as Mr. Talcott's letter of August 29th, is mostly written in that "key," we shall pass unnoticed that part where he endeavours to shelter his total misconception of the principles of Locomotive Engines behind the trifling inaccuracy in the copying of figures from De Pambour, which accidentally occurred in our first communication, having taken, instead of 56·5, the number 58, which stands just above it in the table of experiments. The unimportant difference resulting therefrom, is 4½ tons in 191, and to every person in the least acquainted with the subject, it will be evident that this cannot in the slightest degree affect the principle in question.

In the 4th paragraph of his communication of August 29th, Mr. Talcott seems astonished that an Engine which is able to draw its maximum load, with a velocity of 13·03 miles per hour, should not be able to move more than the same load at a velocity reduced to less than one-fourth. To this we can only reply, (as we have already in our first communication quoted from De Pambour) that whenever an Engine moves its *maximum load*, the pressure of the steam in the cylinder becomes equal to that in the boiler; and so soon as this is the case "there is no further diminution of velocity that will permit to increase the load, for an increase of load requires an increase of moving power, which is no longer possible."

Mr. Talcott then attempts to show that the load of an Engine can be increased beyond its maximum, as determined by De Pambour's formula, from the single fact that in one of the experiments the Vesta Engine drew 189 tons, when, according to the formula, its maximum load would only be 186·4 tons. This trifling difference of 2½ tons in 186, being about 1⅓ per cent., can certainly not induce any one to doubt the correctness of the formula. In fact, as De Pambour himself suggests, "if the result of the experiment seems a little larger than that deduced from calculation, it is because he has reckoned the tender at an invariable weight of 5 tons—whereas during this experiment the consumption of water and coke must have made it descend considerably below that weight, though he had no possibility of weighing the tender, and consequently could not take the difference into account"—(vide De Pambour, chap. VI. §4). Suppose now that the average weight of the tender had been only $4\frac{1}{4}$ tons, instead of 5 tons, as De Pambour assumed, then as the experiment was performed upon a plane of $\frac{1}{89}$, the gravity of this $\frac{3}{4}$ ton would have been 18·8 lbs., which is equal to the traction of 2·4 tons on a level. Thus, the difference between the maximum load of the engine, as determined by the formula, 186·4, and the result of the experiment, 189 tons, is clearly accounted for.

As to Mr. Talcott's first query, "how is it that this Engine, which should be able to draw 186·4 tons, at 13·3 miles per hour, can only draw 129 tons at the rate of 12 miles per hour?" We reply, that this Engine *did* draw more, for on the 1st August it drew 165 tons, with a velocity of 14·11 miles an hour, and a pressure of 55lbs. (vide De Pambour's experiments). Yet, Mr. Talcott thinks fit to omit this experiment when, as he says, he "gives the results of *all the experiments* made by De Pambour with this Engine, when the load was so great that it could not reach a speed of 13 miles per hour." It is evident, therefore, that as the Engine drew 165 tons, with a velocity of 14·11 miles per hour, and a pressure of 55lbs, it could not have been working in its right state when it only drew 129 tons at 12 miles an hour with an increased pressure of $56\frac{1}{2}$lbs, consequently, this experiment is not at all in point. This, and what we have said before, will also solve Mr. Talcott's second query.

As to the experiment of De Pambour, which Mr. Talcott states to vary from 10 to 100 per cent. from the results obtained by the formula, it must be borne in mind that these experiments have no bearing whatever upon the correctness of the formula, which are intended only to furnish the principles upon which the proportions and effects of locomotive Engines must be determined *when the Engine works in the right state.* Circumstances will frequently occur that may cause the Engine to perform less than it would if working in its right state; and such must evidently have been the case in many of the experiments adduced by De Pambour. In fact, the only reason why he has communicated them, as he himself says, is "to show what may be expected from Engines in their daily work."—And he furthermore explains, in the most lucid manner, in Chap. V. sec. 4, many of the circumstances which may cause the effect of the Engine to be diminished, and the reason why "in the experiments we see the speed go sometimes down to two and three miles an hour." In a word, De Pambour's formulæ show what Engines can do and ought to do, and not what, under *ordinary management*, they really do.

Mr. Talcott states that De Pambour, in one of his practical tables, has employed the formula

$$V = \frac{mPSD}{(F+9M)\,D+sd^2l}$$

in the same manner with himself and Mr. Johnson, and obtained a result where the resistance on the piston is greater than the pressure of the steam that is to move it. This, however, is not the case; De Pambour could not have been guilty of such an absurdity, against which he so repeatedly cautions. We cannot better refute this charge, than by quoting De Pambour's own words, preceding the practical table of the velocity of Engines with given loads, &c., in which Mr. Talcott has descried the error. "As we have been necessarily obliged to confine ourselves, in each column, to the limit of the load which the Engine is capable of drawing at the pressure indicated after the formula in section 4,

$$\left(M=\frac{(P-\iota)\ d^2 l}{(\varepsilon+n)\ D}-\frac{F}{\varepsilon+n}\right)$$

so it follows, that the same table gives equally the maximum loads for each pressure, as well as their corresponding velocity."

The instance to which Mr. Talcott alludes, occurs in that table, where the maximum load of an Engine, with 12 inch cylinders, 16 inch stroke, 5 feet wheels, 152 lbs. friction, and 42 lbs. effective evaporating power, with an effective pressure of 60 lbs., is given as 255 tons, with a corresponding velocity of 10·91 miles an hour, when it should have been 238 tons, with a velocity of 11·3 miles an hour. This error does not arise from De Pambour's misapplying his own formula, as Mr. Talcott would have us believe, but from the simple fact, that De Pambour, in the computation of this case, according to the last mentioned formula, has inadvertently omitted to subtract the last term $\frac{F}{\varepsilon+n}$, which produced the result of 255 tons, as stated in the table.

Mr. Talcott seems entirely to have forgotten that, in our first communication, where we change the above equation to obtain the resistance on the pistons, in the imaginary case of Mr. Johnson's Engine, we did so intentionally, and with the view of showing *him* that the formula worked right both ways, for *he* in his first letter to Mr. Johnson had taken the paradoxical position, that the formula in one way, when applied to determine the load, is totally wrong; and in the other, when applied to determine the resistance on the piston, " not precisely correct, inasmuch as no allowance is made for the imperfect application of the Engine's power through the crank motion. Mr. Talcott's sole objection, then, to the entire correctness of the formula, when applied to determine the resistance on the piston, is the antiquated error of loss of power in Steam Engines, by the transmission of the motion through the crank, which the merest tyro in the profession, now-a-days, can demonstrate to the contrary.

Mr. Talcott closes his communication with a most disingenuous attempt to condemn De Pambour out of his own mouth, and to lower the value of his work by quoting a passage from the preface, where, he says, that he " by no means pretends to have produced a perfect work."—Surely this remark does not testify against the correctness of the principles which De Pambour has established; and every liberal mind will at once perceive that it was prompted by that modesty which invariably accompanies true merit and learning, and which differs so widely from that self-sufficiency with which Mr. Talcott, in his first letter, pretends to " disseminate nothing but correct information on this subject."

This discussion has already been protracted to an unnecessary length, and it may be almost deemed presumption in us to fill the pages of your Journal with a defence of De Pambour, after such men as Professor Barlow, Professor Whewell, and Nicholas Wood have, in their works, borne unqualified testimony to the distinguished merits of De Pambour, and expressed their entire confidence in the results at which he has arrived. But Mr. Talcott told us in his first communication, that it would be easy to *show* wherein the formulæ are wrong, and that he designs to do so hereafter; and Mr. Johnson, in his comments upon that communication, tells us that Mr. Talcott "feels confident that he will be able to present correct formulæ for all practical velocities." Now, ***this we call upon him to attempt***, and when the errors are pointed out to us, and the *correct* formulæ laid down, we promise them a careful examination, without reference to the "feelings" of any one. In the meantime we confidently predict, that the more profound the research which investigates De Pambour's formulæ, and the more rigid the comparison of the results with *appropriate* experiments, the more complete will be the conviction of their sterling accuracy.

Very respectfully your's, C. E. Detmold.

October 9th, 1838.

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*Description of the Construction of the First Division of the Long Island Railroad, with Remarks. By an* Engineer.

(Continued from page 217.)

Two modes of laying the sills for the superstructure have been mentioned: one with single, and one with double sills. When single sills or plank was used, they were either of three or four inches in depth, and at the junctions of rails, as well as at the junctions of sills, additional pieces of plank, of three to four feet in length, were laid to strengthen these points, as shown at B and C, in figures 2, 3 and 4. In practice it will be found difficult to make the bottom of the sleeper, and the three pieces of plank at C to coincide; it will also be found difficult to make the beds or sand, on which these planks rest, equally solid throughout; the result is, that the sleeper, instead of resting on the three, rests probably in the first instance on one, and therefore settles to a degree with the first load which passes over it. It was thought that a firmer road, possessing a more equal bearing throughout, could be made by using two planks, one laid on the top of the other, and breaking joints; that is to say, the joint of the one plank never corresponding with the joint of the other. So much additional plank is applied at the junction points where single planks are used, that the application of double plank throughout increases but slightly the expense: the planks vary from 10 to 18 feet in length, they may average 15 feet each—this will give 352 planks to the mile; there will consequently be 352 junctions having additional pieces, as shown at B, each three feet in length, or taken together, six feet. The iron rails being 16 feet each, there will also occur 352 junctions of rails having additional pieces, as shown at C, each three feet long, or both, six feet; if the plank averages 9 inches in width and 3 in depth, we have $352 + 352 = 704$ pieces × by 6 feet, $= 4224$ feet of plank, $= 9504$ square feet of timber; when double sills are used the additional plank amounts to 5,280 lineal feet of plank, $= 11,046$ square feet of timber; the additional timber used with double plank, or the difference being thus, 1,542 sq. feet, or including both rails, 3,084 sq. feet, which estimated at $14 per thousand gives an amount of $43 17. The double plank will be greatly strengthened at the junction sleepers, by driving a couple of spikes through both planks, one on each side of the sleeper.

The sleepers used on the Long Island road, and also on the Boston and Providence, and the Stonington roads, are of the white cedar tree. There are two trees of this name; one, the white cedar proper, which is found along the coast from South Carolina to Connecticut, but never farther north than this last State. The other, from which these sleepers are obtained, is more properly termed the '*Arbor vitæ*,' and is known by that name in the northern States, as well as by the name of the white cedar; it is found plentifully in Vermont, Maine, and Lower Canada. The sleepers were procured from the neighbourhood of Bangor, in the State of Maine. A far superior wood, however, and the hardest and most durable which I have seen applied to this use, is that laid on the Jamaica railroad. The sleepers laid on the Brooklyn and Jamaica railroad are of red cedar; this is a much tougher, more durable, and in every respect superior wood to the white cedar; it is the '*Tuniperus Virginiani,*' which grows abundantly in Virginia and on the borders of Lake Champlain. I have not learned where the Jamaica sleepers were obtained. The hemlock, from which the longitudinal ground sills are procured, is found abundantly in the States of Maine and Vermont; it is also found on the banks of the Hudson, in New-York, on the Catskill mountains. That used on the Long Island railroad was procured in part from Maine, and in part from New-York. The sleepers used at the junctions of the rails are always the largest; even with this advantage, however, and the additional plank laid at the same points, the road is evidently weak there, and may, in many instances, be observed slightly to give with every train which passes over it. The general looseness of the spikes at the junction sleepers, will farther evidence this assertion; and on the road the gravel or sand about the junction sleepers will often be observed to be loose and shaken, while that in contact with the intermediate sleepers is unaffected; it is very evident, therefore, that the additional means used at present to strengthen the points where a junction of rails occurs, are not sufficient. The mode of connecting the chair to the sleeper is indeed defective, but this is not the only cause of the evil; were the chair so secured that the spikes could not loosen, the strokes which the sleeper and its foundation receive on the passage of every train, would be less severe, because the weight, and the resistance of the earth by which it is surrounded, would present united a greater obstacle to the elasticity of the rail than occurs at present with spikes so easily loosened or removed; but had the foundation itself been sufficient, there should not in the first instance have been any movement of the rail, and hence no vertical strain on the spikes to loosen or raise them; the strain being less on the other sleepers, and the weight of the train disturbed in their case by the unbroken rail, over several, instead of being altogether received by one, they are rarely affected in comparison. To remedy this evil on a wooden superstructure, to which our remarks are confined, the Engineer of the Baltimore and Susquehanna railroad has adopted what, in connexion with the provisions now made, would appear to be a very efficient plan. It consists in applying two sleepers at this particular point, and thus distributing or reducing the weight and strain for the one sleeper, or for an equal base, one-half; the manner of effecting this is shown at figure 17, where *a a* are the sleepers, (which on that road rest on broken stone) *b* a transverse piece of wood, three feet in length, sunk into the sleepers and resting on them; *c* the chair resting on the centre of the cross piece; *d d* the rails, and *e* their point of junction. The weight resting on the rail, and thence on the chair, is evidently communicated thus to two sleepers, instead of one, and therefore these sleepers, and the foundation on which they rest, support respectively but one-half of the weight which would be encountered were there but one sleeper in their place; or viewing the space now occupied, the base at the junction is about tripled. On the intervening points, the sleepers meet the rail in the ordinary way. It will be perceived that by this mode the junction sleepers must always be placed lower than the intermediate sleepers, and that therefore with a plank foundation, there would occur a break in the continuity of the sills at every junction; this, however, may be obviated, and the same advantages secured with a foundation of continuous sills,by using instead of the pieces of timber *b*, and the chair *c*, a casting which shall combine both without requiring to be sunk more than an inch into the sleepers, and therefore without weakening them so much as at present; the centre of the casting would be raised to receive the ends of the rails, and prevent them from resting on any point but the centre, and in this way, the ends resting on either sleeper, the weight would be distributed just as it is at present. These castings, however, would be so heavy, and therefore so expensive, as to be out of the question at present; we are therefore, driven, again either to rest satisfied with the single sleeper, or to modify Mr. Trimble's mode of using timber, so as to render it applicable to a sill foundation. It is obvious that the benefit obtained by this plan, is altogether in proportion to the distance between the two sleepers, supposing always the transverse beam to be inflexible; and it may be considered so practically, on three or four feet of distance. If we had a single sleeper occupying the same width as the two sleepers, the same disadvantages would obviously be obtained, the bearing would be increased in the same proportion, the weight would rest on a space equally great. Figure 18 shows a mode by which the advantage might be gained; the transverse beam *a a a* rests solidly on the sills; it is connected to two sleepers, *b b*, for the purpose of securing its position, and preventing lateral displacement. The sleepers are notched and countersunk into the transverse beam, which may itself be a piece of a heavy sleeper: the depth 8 inches, and the width 10; the space between the sleepers may be 2½ or 3 feet; the bearings of ordinary sleepers do not exceed 8 inches: these, therefore, would exceed them in the proportion of rather more than four to one, and being efficiently held in place by the connecting sleepers, would be equally secure in that respect. The chair would then be laid on the centre of the beam at *c*, in the usual way.

I have now to propose a modification of the chair in use, but will first request attention to a short description of the superstructure of the Jamaica railroad, as designed and constructed by Mr. Douglas. Fig. 26 represents the rail of the Jamaica road, and figs. 23 and 24 the corresponding chair; the projection on the base of the chair admits of the surface of the rail occupying a lower, and therefore firmer position, with respect to the sleeper on which it rests, than it otherwise could do This projection is neatly fitted into a corresponding notch in the sleeper; the rail is thus rendered exceedingly secure from displacement laterally; the lateral strain is now thrown directly and immediately on the sleeper, instead of through the intervention of the spikes as formerly,—the spikes being exempted from this particular force, may be made much smaller, and for this chair a screw nail of about $\frac{3}{8}$ inch diameter is used instead of a spike—it will weigh less than $\frac{1}{3}$ of the weight of the common spike used with the Providence rail: from the form of the chair, however, and its peculiar connexion with the sleeper, this screw is found to answer the purpose very well, and when compared with the spikes before mentioned, is found, under like circumstances, to be less often drawn or displaced. Fig. 25 represents the form and size of this screw. Fig. 27 represents the superstructure as laid on the Jamaica railroad: *a a* being the chairs and rails, the rails 4 feet 8½ inches apart in the clear, *b* the sleeper, and *c c* flat stones, or pieces of paving stone, about 20 inches square and 4 deep, on which the sleepers rest. These stones are laid on the natural earth, whatever that may be. The whole fabric displays more ingenuity and valuable adaptation than any construction of the kind which I have seen; it requires but additional strength, (which Mr. Douglas, I understand, proposes to give it,) and a faithful foundation, to render it the most economical rail at present known.

The chair which I propose to apply, is intended to take advantage of that feature in Mr. Douglas's chair, which relieves the spikes or bolts from the lateral and horizontal strain communicated to the chair, and throws it directly upon the sleeper; this advantage, we believe, can be gained without cutting so deeply into the sleeper as Mr. Douglas has done—no advantage in respect of stability being gained in this case by great depth with the "Long Island" form of rail. The form of chair laid at present on the Long Island railroad, has already been described; it is shown at figs. 8 and 9. The form of chair laid on the Stonington, Boston and Providence railroads, with the same form of rail, is shown at figs. 19 and 20; it differs from the Long Island chair in the situation of the holes for the spikes. The pieces *b b*, fig. 8, on the Long Island chair, fit into corresponding notches in one end of the rail, and prevent the longitudinal motion of the rail, so far as the strain of the machinery is concerned; the rail being, however, confined thus only at one end, its expansion by heat is not prevented. The chair, figs. 19 and 20, has its holes for the spikes so placed, that the spike itself fits into the notches in the rail, which, with this chair, occur at both ends of the rail; the horizontal motion of the rail is therefore prevented in this case, not by a projection in the chair, but immediately by the spikes. In either case the chair must be considered merely as a plate on which the rail rests; when the spikes are loose the rails are loose, or if the two spikes of one rail are loose while the other two remain firm, that rail rises and presents a dangerous obstacle to the cars. It is true that the great strength and stiffness of the rail prevent the ends from differing so much as they otherwise would do, or bending to a dangerous extent in the manner in which plate rails are bent under similar circumstances; there is still danger, however, when the machinery is in rapid motion, of the cars being thrown off the track, even by differences of half or three-quarters of an inch, which sometimes occur with this rail. It will be admitted that the danger would be greatly lessened, if where the one rail was loose, and rose, the other rose simultaneously to the same extent, so that their line of surface should always agree; in other words, that the one rail should not rise without the other. This would be the case were the chair so formed as to connect with and bind the rails; where the spikes or bolts got loose in this case, the rails would carry the chair with them, but the form of the chair would still maintain an uniform connexion at the joints, as may be seen by reference to figs. 21 and 22. In fig. 21, the projection *a* is fixed, and secures one side of the rails; that the rails may be made firm, the other projection *b*, of which *b'* is the same in profile, is moveable, and fits into the projection on the plate *c*, (see also fig. 22 and the profile of this part of the plate,) the hole in which corresponding to the hole in the moveable piece, but a little in advance of it, admits a key of a wedge form, by driving which the piece is forced upon the rails, drives them close upon the opposite side of the chain, and secures them from rising by the form of the point of the moveable piece *b*. The ends of the rails are cut at present by a machine, for they are rarely of the same size at the ends, and it is necessary that they should exactly correspond; er. The chairs may always be made to fit the rails within $\frac{1}{12}$ of an inch on the bed, and therefore there is no occasion for a greater provisional allowance either in the hole or in the key. The nearer all the parts approximate to perfection, as received from the manufactory, of course the better. The projection *d*, fig 21, is intended to fit into a hole of the same size in the sleeper, by which means the bolts or spikes will be relieved, in a great measure, from the lateral strain. The small projections, *d d*, fit into corresponding notches in one end of the rail for the purpose of securing it from longitudinal motion as heretofore: with this chair, screws should be used of about $\frac{1}{2}$ an inch in diameter; experience proves that spikes are too easily raised.—The two screws of this dimension will, combined with the projection, probably render the chair very firm; and as about $\frac{1}{3}$ of the iron used for four spikes will answer in this case, the cost, in this respect, will not be increased. This chair will weigh about 12 lbs.; something more compact will probably occur to others which they would continue to be cut, but this part of the process ought to be perfected at the manufactory, where it can be done both better and cheap- will at once improve the form and reduce the weight. Of the spikes used on the intervening chairs, the ragged form, fig. 12, has proved far the best; something better is however required. The absolute necessity for something better is not indeed so apparent while the same strength and weight of rail is used, yet the spikes frequently get loose, and there is not a little iron wasted in repairing, which is generally done by driving a new spike on another part of the sleeper. The truth is, the stiffness of the rail, if combined with a *firm superstructure*, is greater than there is any occasion for; with an imperfect superstructure it is absolutely necessary,—it reduces and dissipates its defects, for the weight and strain, instead of being communicated to the spikes of one sleeper, is dispersed over three at least, if not partially over the whole rail; while therefore the same weight of rail continues to be used, the same mode of spiking may sufficiently answer.—Should, however, the road be improved in other respects, the weight of rail may safely be reduced, and what was previously due to imperfection of foundation, may then be dispensed with; in that case, a more efficient mode of spiking on the intermediate rests will be found necessary, since the strain communicated to each sleeper and its fastenings will be increased. It is doubtful whether any form of spike will then answer so well, as a small casting on either side of the proper form, binding closely the rail, and secured by a bolt or screw.

The rail laid on the first division of the Long Island road is very massy; with the exception of the Stonington rail, which is $\frac{1}{2}$ lb. per yard heavier, and the Baltimore and Pennsylvania rail, which is $58\frac{1}{2}$ lbs. per yard heavier, it is the strongest rail used in the United States; its simplicity is its prominent characteristic,—chairs are dispensed with except at the junction sleepers, and the rail is easily and securely laid by ordinary hands.—It is particularly applicable to a timber superstructure, and as already remarked, it is enabled to reduce the defects of a temporary and imperfect superstructure by the qualities of uncommon strength and stiffness; the rail is, therefore, practically the best in use in this country. There are many other rails, and particularly the Jamaica rail, which would be greatly superior in every respect, with an efficient and solid superstructure and foundation; but with the superstructures in use, or likely to be in use for some time, they are comparatively easily disarranged;—they are made for a more perfect state of things than now exists, and are therefore not so practically efficient as the other which has taken into account the contingencies and imperfections of the time in which it is laid.

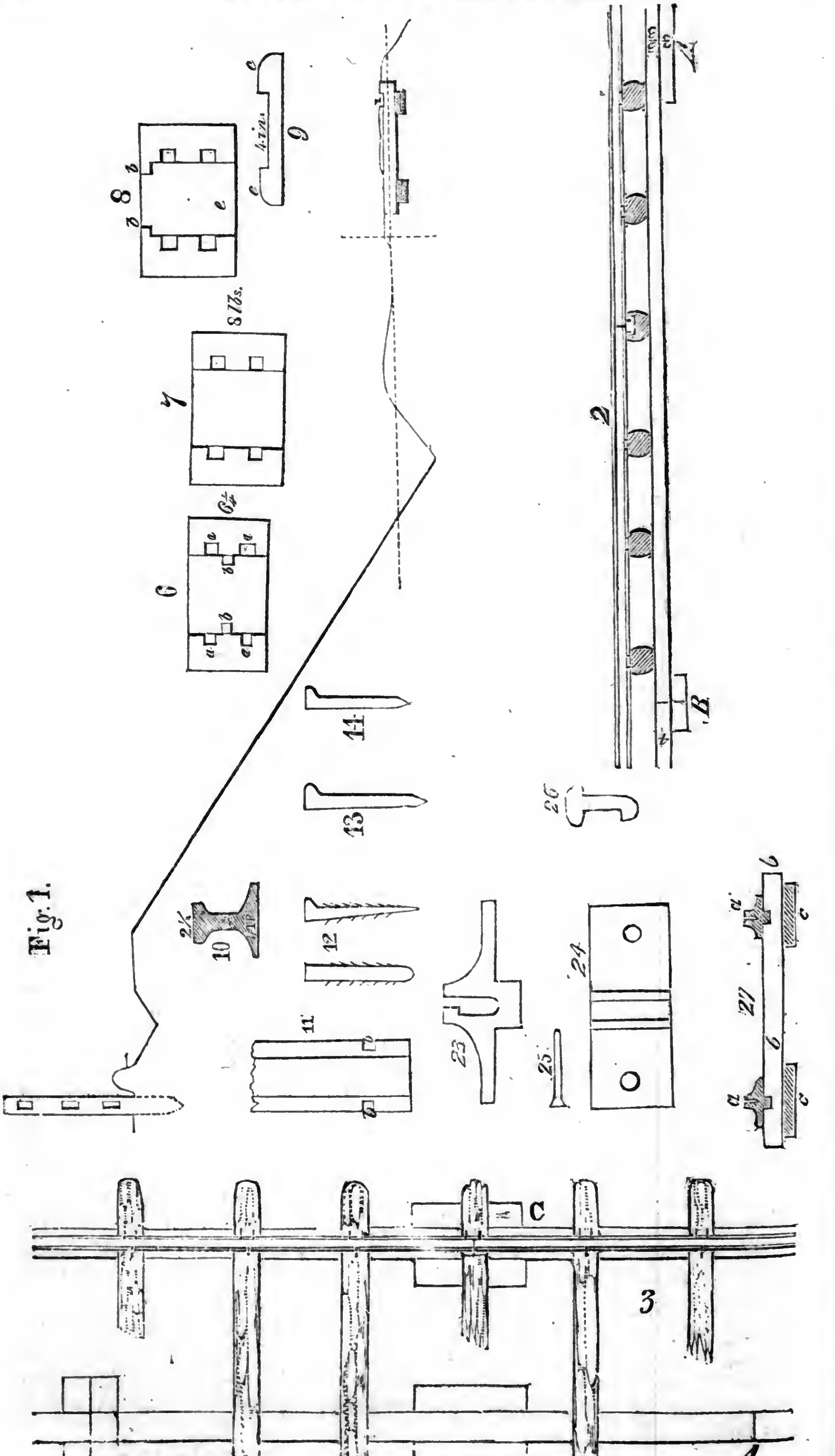
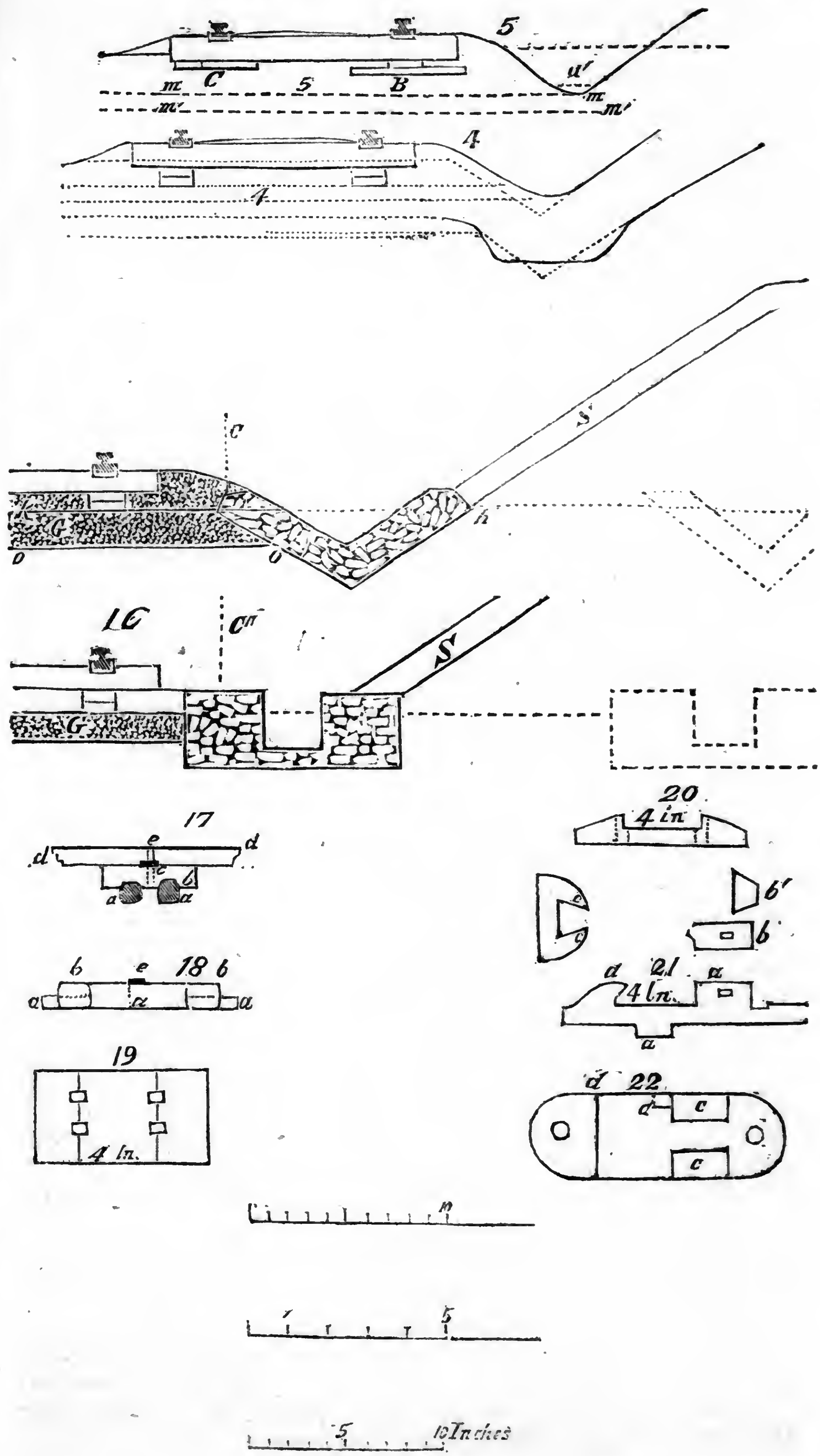


Fig. 1.
2
3
4
6
7
8
9
10
11
12
13
14
23
24
25
26
27
8 lbs.
B
C


5
C
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m
m'
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4
S
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h
o
G
16
S
17
d
e
c
b
a
18
20
4 in
21
4 In.
19
4 In.
22
10 Inches

## EXPLANATION TO ACCOMPANY PLATE NO. II.

### Diagram, No. 1.

The figures at top and bottom indicate the hours.

The figures at either end the miles.

The hours are also indicated by the vertical dotted lines.

The mile figures refer to the short black lines at either end, which may be connected at pleasure to understand their relation to the times of a given train.

The trains moving at 20 miles an hour, are represented by full diagonal lines.

The trains moving at 15 miles an hour, are represented by dotted diagonal lines.

The points of intersection of these lines indicate the position of the turnouts.

The time intervening between the starts is in all cases one hour—no other division will correspond with this table.

In this and the following diagram, the *quick* trains are supposed to start from Brooklyn at eighteen minutes before any full hour, from Bedford at twelve minutes after; the accommodation trains, from Brooklyn, at six minutes after any hour; from Bedford at thirty-six minutes after.

Scale No. 1, represents the turnouts, or passing places, required under such an arrangement. The full black lines crossing the scale indicate the position and number of the passing places required to accommodate trains starting every hour from either end, with a uniform velocity of 20 miles an hour. The dotted lines crossing the scale show the additional passing places which would be required to accommodate another set of hourly trains, but travelling with a uniform speed of 15 miles an hour.—The letters refer to the corresponding intersections in the diagram. It need hardly be mentioned that the times of starting from either end are mutually dependant.

### Diagram, No. 2.

The figures at the top and bottom indicate the *hours*.

The figures at the other end the miles.

The hours are also indicated by the dotted vertical lines.

The miles are also indicated by the horizontal full lines.

The trains for the Boston travel moving *from* Brooklyn, by the dark diagonal *full* lines.

The accommodation trains, moving *from* Brooklyn, by the light diagonal *full* lines.

The trains with the Boston travel moving *towards* Brooklyn, by the dark diagonal *dotted* lines.

The accommodation trains moving *towards* Brooklyn by the light diagonal *dotted* lines.

The starting times from Bedford by the letters A B C, &c.

The starting times of the corresponding trains returning from the eastward, by the accented letters, A′ B′ C′, &c.

The points of intersection indicate the position of the turnouts.

Scale, No. 2, (to the Diagram) represents the number and position of the turnouts required for a daily accommodation of eight trains from either end, starting at the times indicated on the diagram, four of these trains at 20 miles an hour, and four at 15 miles an hour.

### Diagram, No. 3.

The figures at the top and bottom indicate the hours.

The figures at the ends, the miles from the respective starts.

The hours are also indicated by the dotted vertical lines.

The miles are also indicated by the horizontal full lines; which lines will also show the positions of the proposed passing places.

The diagonal full lines show the trains moving *from* Brooklyn.

The diagonal dotted lines show the trains moving *towards* Brooklyn.

The points indicated by the letters A B C, &c. show the times of starting from Bedford.

The accented letters, A′ B′ C′, &c. indicate the starting times of the corresponding trains returning from the eastern end.

The points of intersection of the diagonal lines, indicate the positions of the turnouts.

Scale, No. 3, (to the diagram) represents the number and positions of the turnouts required to accommodate a daily trade of eight trains from either end, starting at the time indicated in the diagram, and having all a uniform velocity of 20 miles an hour.

Note.—For this mode of exhibiting by diagram the relative positions of trains on a railroad, the writer is indebted to Geo. W. Whistler, Esq.

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☞ In making wood cuts from the lithographs belonging to the pamphlet, we have been obliged to curtail some of them, but not in any way to injure their representation.

The first Scale relates to figure 1, the second to figures **2, 3, 4, 5, 15, 17, 18,** and **27**; the third, to the remaining figures.

We have been obliged to omit the profile of the road, and also the Diagrams referred to as plate II, as from their great size it is impossible, in any way, to bring them within the compass of our page. We regret this the less, as the method of constructing them is so fully described in the text.

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## *The Philadelphia and Reading Railroad.*

This Road extends from Philadelphia to Reading, Penn., and is intended, with its extension to Pottsville, to form a continuous Railway communication between the anthracite coal regions of Schuylkill Co. and Philadelphia.

The grading of the 40 miles between Reading and Norristown, including the Black Rock Tunnel, was completed early in 1838; a single track was laid, and the Road opened for travel between those places on July 17th, 1838, since which time it has been in successful operation, without the occurrence of any accident attended with serious consequences.

That portion of the Road between Norristown and the foot of the inclined plane on the Columbia (State) Railroad, where it joins the latter, including the Flat Rock Tunnel, is expected to be completed in the course of next summer; and the Coal Trade Branch, which leaves the former route at the Schuylkill Falls, about five miles from Philadelphia, and debouches at Richmond, on the Delaware, it is calculated, will be finished simultaneously with the extension of the Road from Reading to Pottsville.

The total length of the Road from Reading to the Delaware is 59 miles; and to its junction with the Columbia Railroad, 53 miles. Reading is about 37 miles from Pottsville.

One of the most important features in this Road, is the uniformity and lightness of its grades, nine of which *ascend* from the Coal Region to Philadelphia, with but one exception, where the high ground between the Schuylkill and Delaware Rivers renders unavoidable an ascending grade of about 1 mile in length. At this point, it is contemplated to have an assistant Locomotive Engine, by the aid of which the trains, with their full loads, will be enabled to ascend without interruption. From the summit of this grade, the descent to the Delaware is about 33 feet to the mile: all the others are either descending, or level. The heaviest grade from Reading to the Delaware, with the above exception, is 18 feet to the mile, for about 17,700 feet; between those points, there are 152.600 feet of level, and the remaining distance is divided into grades, varying from 1·5 to 11·8 feet per mile.

With these grades it is calculated that a Locomotive Engine can, with ease, take 200 tons of coal down the Road, and bring back the empty Cars to the Coal Mines.

The general character of the grading on this Road is heavy, particularly the grading of the first five miles from Reading, where the Road winds round the base of the Neversink Mountain.

About a mile above Phœnixville is the Black Rock Tunnel, the longest in America, which cuts off a bend of the river nearly 3 miles round. It is 1.932 feet long, cut through solid blue slate rock the entire way, 19 feet wide, and 17·2 high. It was worked from the ends, and from 5 vertical shafts, one of which was 140 feet deep from surface of ground to grade of tunnel. It cost $150,000.

On the same line with this Tunnel, and immediately adjoining it, is a beautiful stone bridge across the Schuylkill, with 4 arches of 72 feet span, and 16½ feet rise each, and built throughout of cut sandstone.

At Flat Rock, one mile above Manayunk, is another Tunnel 960 feet long, through solid Gneiss rock, which is now more than one-third completed.

The surface of this Road is 21 feet wide on embankments, and 25 feet in cuts, with side ditches in the latter 1½ feet deep. Its side slopes are 1½ base to 1 rise on embankments; 1 to 1 in earth, and ⅓ to 1 in rock cuts.

In the wood-work of Bridges on this Road, Irvin's Lattice for spans over 40 feet has been adopted; and for spans under that length, the King and Queensport Truss, and simple joist forms—the Lattice Bridges being built of white pine, and the others of white oak, timber.

The Culverts are built of stone throughout, generally with semicircular arches of from 6 to 50 feet span.

The superstructure consists of the T rail, laid upon white oak sills, or sleepers 3 feet 1½ inches apart from centre to centre. The rail is 3¼ inches high,—its upper surface 2¼ inches, and lower 3¼ inches, wide, with a stem ⅝ inch thick. It is rolled in lengths of 18 feet 9 inches, and weighs 45 lbs. per lineal yard. The sill is 7 feet long, and 7 by 8 inches square, laid on its flat side.

The joints of the rails fit into a cast iron chair, shaped to receive exactly the whole of the under surface, and one side of the end of each rail, which is furnished with a bolt hole, through which, and a corresponding one in the chair, a screw-bolt passes, nutted on the inside, making a perfectly true and level joint, and securing the ends of the rails firmly to the chair. Between the ends, the rail is fastened to the sills by a bill headed ½ lb. spike, which clamps the rail down to a ¼ inch notch cut in the sill: no intermediate chairs being used, as with most other solid rails.

Under the whole length of every sill, a trench 8 feet long is dug, and filled to the depth of 14 inches with broken stone, well rammed, in three separate layers In rock cuts these trenches are, of course, dispensed with, and the sill laid upon the bare rock.

When the unevenness of the country through which the road passes, and the sudden bends of the River Schuylkill, whose valley it follows the entire way, are considered, its curvature will be found remarkably light; the shortest radius of curvature adopted being 819 feet, and but 1480 feet struck with the radius. The other curves generally average from 2000 to 3000 feet radius.

In the excavations of the Road, various geological formations are exposed; as, commencing at Reading, limestone, quartz, breccia, red slate with sandstone intermixed, sandstone, blue greywacke slate, through which the Black Rock Tunnel passes, sandstone and gneiss rock, of which the Manayunk Tunnel is composed.

The scenery on this Road is unsurpassed by any other in the country. Following the course of the Schuylkill, it presents to the traveller those picturesque views for which that River is remarkable: these are of the most diversified character, from the wildest mountain scenery, where the Road winds round the foot of a lofty hill on a narrow ledge cut with immense expense from the solid rock, to the smiling landscape, where fields rich with fertility afford a pleasing contrast on escaping from rugged and precipitous hill sides.

It is thought the Road will be completed from Reading to Philadelphia, via the Columbia Railroad, sometime in the course of next summer or fall; and the whole line to Pottsville in about two years.

The total cost of the Philadelphia and Reading Railroad, when completed, including depots, tunnels, and a double track of edge rails, it is supposed, will be about $45.000 per mile. It was commenced in July, 1835;—Messrs. Moncure & Wirt Robinson, Engineers.

Reading, Sept. 28, 1838.

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## *Remarks on Steam Navigation, Explosions, and Engineers.*

From the Army and Navy Chronicle.

The results of the recent passages across the Atlantic by several different vessels propelled by steam, together with the increased facilities in travelling, and the transportation of merchandise secured by this agent, both on our rivers and along our coast, have very justly excited the amazement of the hitherto incredulous, as well as the attention of the enterprising. The practicability of the application of steam for the navigation of the ocean is no longer problematical. Let prejudice and scepticism be henceforth discarded, and the incubus that has lain upon the prosecution of the first successful attempt (some twenty years since) be removed; and let an early prophecy be fulfilled to its widest extent:

"Soon shall thy arm, unconquered steam, afar,
Drag the swift barge or roll the rapid car."

Americans should not have lost sight of their success, and allowed a rival nation to have prosecuted its experiments with a spirit that acquires additional lustre from their supineness. Why American enterprise has succumbed in this instance, is a query that must naturally present itself. Would that an answer could be given, as satisfactory as the character of our countrymen for the possession of such a quality is proverbial. But, as an excuse can be given, and one too that exonerates the majority at the expense of a few, it is but fair that it should be offered.

Steam Navigation, it is well known, on this side of the Atlantic, until within a very few years, with but some temporary exceptions, has been exclusively confined to our bays and our rivers. The comparatively smooth water of the former, and the shallowness of the latter, have induced an appropriate structure of vessel, and form of engine. The one unrivalled in beauty and speed, and the latter in economy and efficiency. Two routes only upon our coast have been established; and the consequence of our want of experience in such navigation, is too deeply felt, and too well known. The owners of the Chancellor Livingstone and New England, at the north, will long regret their temerity, while the loss of the Home and Pulaski will not soon be forgotten at the south. The immediate cause of the destruction of these vessels, with but one exception, has been owing to an improper construction of their hulls, they being too light, and their depth of hold too shallow for the length of keel; for strange as it may appear, the plan and proportions of river steamboats have been carried out, in those intended to navigate the ocean. How then can it be wondered at, that, with the conviction of the impropriety of such a course as that pursued on the part of some few individuals who have catered for the public convenience, British steam navigators should seek to introduce their vessels among us, and that our accustomed enterprise has received a temporary check from the inexperience of some, and the inexcusable temerity of others. That it is but a temporary check, the writer is convinced; and he trusts he is not singular in this position; for, strange as it may appear to those who are unprepared to meet with the assertion, yet it is nevertheless true, that the American steam engine, in its application for the propelling of vessels upon the ocean, and particularly for long voyages, on account of its compactness, speed, efficiency, economy of cost, and fuel, is beyond comparison with those manufactured by any other country. In support of this declaration, he not only defies a refutation, but advances an instance in corroboration, of which it can be truly said—*Ex uno disce omnes.*

The British steam ship Great Western is propelled by engines of 375 horses power, at their ordinary speed and pressure of steam, (which approaches to within a shade of their maximum power;) they occupy a space, including boilers and fire rooms, of 56,100 cubic feet, and weigh, together with the boilers and water, 588 tons, and consume, at the very lowest estimate, one and a quarter tons of coal per hour. Whereas, the United States steam frigate Fulton (built in New-York) has engines of 460 horses power, at their ordinary rate, though capable of being worked to 936 horses, which occupy but 26,622 cubic feet, boilers and fire room also included, weigh but 207 tons, with boilers and water, consume but a like quantity of fuel, although of 85 horses power greater, and drive her wheels at an excess of speed of $2\frac{2}{3}$ of a mile per hour over the Great Western's.

From this difference in proportions, (not only existing in the above cited instance, but being characteristic of the engines of the two countries) it is evident, that a vessel of the same tonnage and model as the Great Western, having American engines, *could be driven much faster, at a less expense of fuel, as well as first cost, would carry nearly* 30,000 *cubic feet, or* 381 *tons of merchandize more, and yet draw but the same water.* With this advantage in the plan and construction of engines and boilers, together with the admitted superiority of our ship builders, in modelling, as well as ability to build a sea steamer, when not influenced by temerity, or dictated to by the cupidity and ignorance of the employer, the prediction is justly warranted that in a few years, American steamers will hold that station in the navigation of the Atlantic, which the above enumerated advantages in one portion, and the known ability of our shipwrtghts in another portion of the necessary work justify. And if any doubt still exists, either respecting the ability of our countrymen to build both vessels and engines, appropriate for the navigation of the ocean, I know it will soon be dissipated, as the question is abont being settled. Ere many months elapse, there will be an American steamer running from New-York to Cuba, that, from my knowledge of the persons about engaging in her construction, I feel confident of a most gratifying result; also from the description given of the Natchez, lately built at Baltimore, a most creditable success is confidently looked for; and although a first attempt, she is not likely to prove an unworthy one.

Thus much in illustration of the advantages Americans possess in Steam Navigation; and if you can spare me a column in your next number, I purpose to treat of Explosions and Engineers.

No. II.

In the previous number, I undertook to show that sea steamers could be built on this side of the Atlantic, the engines of which, in point of cost and economy of space, in speed, and consequent efficiency, far excel those manufactured in the only country that pretends to approximate to us in the design and construction of them.—But assuming our engines, boilers, and vessels to be all that can be reasonably asded for, or all that we profess to beable to produce, and even such as to throw all competition in the back ground, yet there is another consideration, an obstacle to be overcome, and one that from its magnitude, the neglect of it heretofore, and consequent ill success, deserves, aye demands, most deliberate and provident attention. Need I say, that I allude to the fearful number of explosions of boilers, that are almost weekly occurring upon our different bays and rivers. However, as the question—"Why do the boilers of our boats burst so frequently, and why are there so few accidents of a similar nature occurring in other countries?" is so often and so justly asked, and as a reply can be given which will exonerate my profession, in a great measure, from the onus of censure that is daily heaped upon it, I will give it; for as injurious effects are the results of objectionable and erroneous causes, a knowledge of such errors should induce correction. Before entering on this subject, it is meet to remark that I would have preferred it taken up by a more competent pen than mine; but as a most unaccountable supineness is evinced by older and abler persons, the task devolves upon others; and would that a conviction of the truth of what I shall say, will follow with but one-half the certainty that ruinous and fatal consequences will be attendant upon a neglect of it.

In a brief sense, and in a great majority of instances, Explosions of steam boilers originate in the errors and prejudices of the Owners and Directors of steam boats, together with an utter ignorance of the subject on the part of the editors of papers, who, in misdirecting their censure, mislead the public; for if a boiler explodes, in consequence of *neglect* and *ignorance* on the part of the person having it in charge, it is not him alone that deserves to be the target of public opprobrium; it is the *employer* that is answerable, for his inexcusable temerity and cupidity in employing an incompetent person. Abuse of the unfortunate object who has either lost his life, or situation, and perhaps only means of support, is not the proper channel in which the indignation of the public should be directed. Neither is it one that will effect a remedy. Let him who, from a mistaken notion of economy, and from an utter disregard of the safety of those who trust themselves in his vessel, omits to exercise a due precaution in the selection of his materials or his agents, receive that meed his unfeeling conduct deserves; and if no moral obligation can reach him, let a physical one be enforced, that will render it incumbent upon him to perform those duties, for the fulfilment of which, by the reception of a consideration, he virtually acknowledges his liability. Let the subject be commented on, in the manner and detail that its importance deserves, and there will not only be less space in our newspapers for idle accounts of "steamboat racing," but less necessity for such notices. For, rest assured that so far from steamboat racing being the cause of boilers exploding, it is a reasonable, if not a sure guarantee of safety. Before, however, due credence can be generally expected, for such an assertion, or before treating of the precautions necessary to be observed in the management of boilers, it is necessary to note the causes of their requiring the most delicate and assiduous attention; without a thorough knowledge of which the proper attention is not likely to be bestowed; neither are the wonted remedies in an exigency likely to be resorted to, when the call for them, as well as their effect, is unknown. Where a thorough knowledge of what is termed the practical operation of boilers and engines is combined with full information of the effects of heat at different temperatures upon water and metals, when the proper attention (the natural result of such knowledge) is bestowed, none other than physical defects are to be guarded against; and even these, with a proper eye to the construction of the boiler and dependencies, or fixtures, can be guarded against, so as to render success and safety all but certain.

I have assumed proper attention to be the result of proper knowledge, upon the principle that it is not to be expected that a man would heedlessly pursue a path at night that he knew led to a precipice; or, that knowing the nature and effects of the gas that is set free by the combustion of charcoal, he would be with his head upon a floor where such combustion was in progress.

Boilers are liable to be burst, or exploded. Engineers make a very wide difference in the application of the two words. The former is construed to be the effect of an escape of water, or steam, in consequence of the pressure exceeding the capacity of the boiler to withstand it, (there being a sufficient, or a requisite quantity of water in the boiler.) The latter denotes the instantaneous disruption of the boiler, when from a defect in the feeding apparatus, or inattention on the part of the engineer or firemen, the water has subsided below the flues, or any portion of the boiler through which flame passes, and water is suddenly admitted. This is in consequence of the steam being exposed to the direct action of the heated metal of which the boiler is made, whereby it is deprived of that, or the corresponding elasticity due to its temperature, which it would possess were it shielded from such exposure by the intervention of water. When water is either admitted through the feed pipes, or thrown up by a sudden heel of the vessel, this intensely heated steam receives that moisture which it requires to give it elasticity, and a pressure is almost momentarily effected that defies restraint. Destruction and death mark its course. This operation is also assisted by the metal (if iron) becoming hardened and partially oxidized, and consequently weakened. When the flues lose the protection of the water, they become intensely hot from the flame upon one side; and being exposed to steam upon the other, the process of oxidation is going on (unless deterred by the presence of "scale.") When water is thrown upon them, the previously exposed portions are hardened, and the tenacity of the metal is almost totally destroyed; thus, increased pressure, and decreased resistance, are the effects of neglect and ignorance in the management of the water in a steam boiler.

Many other causes of explosions might be furnished, in illustration of the necessity for that never-ceasing supervision which boilers and engines require when in operation; but as neither my limits nor leisure will admit of treating them in detail, I must content myself with one other recital. The water in a boiler is liable to "foam:" that is, the water from various causes becomes thrown into a violent state of ebullition, and when the gauge cocks are opened, unless the proper attention is bestowed, it will not be detected. Not only will the necessary, but even a greater quantity of water appear to be indicated; and if the feed cock is opened, the fireman will naturally shut it, perhaps "blow off," and satisfied with having *examined the height of water* for a period, will turn his attention elsewhere; perhaps listen to a tale of some travelling acquaintance or officious querist. In the mean time the quantity of water in the boiler is rapidly decreasing by evaporation, and then the boat approaches a landing, the engine is stopped, the ebullition immediately subsides, and the level of the water falls below that of the flues. The steam becomes highly heated without the steam gauge indicating a corresponding pressure (in consequence of the want of elasticity.) The gauge cocks may, or may not, now be examined, although due regard to safety would imperatively require it, and if examined by the fireman alone, and the water discovered to be below the lowest cock, (generally from four to five inches from the upper surface of the flues) afraid to tell the engineer of his neglect, he runs the chance of there still being an inch or two left over the flues. Perhaps the passengers may have heeled the boat on the side of the gauge cocks, and the lower one vents some water. The engine is now set in operation, (the boat having shoved off,) foaming takes place, the feed cock is opened, the water is thrown or rises upon the heated metal, and all the consequences detailed above, result.

This, together with the one cited above, are admitted to be the most general causes of explosions, and as they clearly show how indispensable attention and information, not usually classed as "*practical*," are requisite, I trust the propriety of not employing any as engineers whose knowledge does not extend beyond the "handling" of an engine, and whose chief merit with many employers is that they are satisfied with a less amount of pay than their predecessors were, (and who, in all probability, were removed to make room for them,) will be evident. I hope to be able to show in another number, that, with the necessary precautions, the services of proper persons can be procured; and that, under their guidance, results will be attained as creditable as the awards of humanity will be certain.

It was not my original intention to have entered into details respecting the cause of explosions; but an exciting interest in the subject has imperceptibly led me on. The subject is one of too much importance for me to handle hurriedly or briefly. With respect to the partial oxidation, of which

I have treated, I am well aware that most chemists will differ with me; but experience, based upon incontestible proofs, has fully guaranteed the truth of such effect to the satisfaction of a majority of engineers.

## No. III.

Having treated of explosions, it is now meet to treat of ENGINEERS; and in so doing, I will explain the manner in which these catastrophes should be guarded against, both with a view to suggest a remedy, as well as to support the opinion I have advanced, of the causes to which these effects are mainly to be attributed.

That boilers, when in operation, require the most assiduous attention, combined with practice and skill in their management, is too true, and too obvious, even from what little has been here, or elsewhere, said of the different risks they are subjected to. No intelligent mind can for a moment doubt the absolute and imperative necessity of allowing their management to be entrusted to none others than those, duly qualified to take charge of them, both by a knowledge of the risks, and the requisite attention to avoid them. But with a general concession as to the truth of this, on the part of the public, how few are they who act in accordance with the natural dictates such a conviction should ensure. Is it not the practice among a majority of steamboat owners, to employ men as engineers, who are only entitled to such an appellation from the tenure of the office, and from the possession of the qualifications of such persons? Is not the amount of pay they ask, or are willing to receive, the usual standard by which their merits are compared with each other? Are not men, who have been but a few months filling a subordinate situation under an *Engineer*, frequently appointed to take his place at an advance in their wages of only $5 or $10 per month, making with their previous receipt some $30 or $35; when their predecessors were in the receipt of nearly twice the sum, and were unwilling to remain even at that, because knowing the extent of their responsibilities, they demanded a fair remuneration? Unfortunately, such is often the case.

Again, even when there is a proper spirit in the employer, his want of knowledge of the duties of an engineer leads him into one of the greatest errors; although not as culpable as the one just recited, it is even a more deplorable one, on account of its much greater frequency. I allude to the infatuation that pervades this class of persons, in their determination to employ none but those they term *practical* men. All the qualifications they consider necessary, are a knowledge of the manner in which the boilers are filled with water, steam raised the engine put in operation, and "stopped," or "started," as occasion requires; which, together with being able to repack the piston, &c., to clean the boilers that their own negligence has allowed to become dirty, constitute their sole recommendations; and the more untidy their appearance, the greater the quantity of grease upon their clothes, the greater are thought to be their qualifications.

Now let me ask, does any reasonable, intelligent person for a moment doubt, that there would not be an almost total cessation of the disgraceful and mournful accounts of destruction of human life, by the explosions of steam boilers, that are almost daily gazetted from one end of the Union to the other, if a fair remuneration was offered for the services of Engineers; if none but men having a thorough knowledge of the principle, manufacture, and operation of the steam engine, were deemed worthy of the situation, and duly compensated for such attainments? and the ignorant and reckless beings who alike disgrace their profession and humanity, were discarded and their places properly filled? Is it natural, I would ask, that a man should be chary of his character and professional reputation, who has but little, if any, stake in society? alike devoid of pride and ambition; whose only care is the procuring of a daily support; and whether in one employ to-day, or in another to-morrow, as long as he receives that support, he recks but little; or should he possess the requisite disposition, it will not guarantee safety when attended with ignorance of his duties. While on the other hand, where a proper pride and ambition are combined with a knowledge of his profession, is it to be expected that he will be neglectful when he knows that death or disgrace will be the consequence? or that he, able to judge of the abilities of his subordinates, would repose confidence in those unworthy of it? Would not the latter be the qualifications sought for by an employer, in other professions and pursuits where pecuniary interests are alone concerned? and why should such be neglected, when both fortunes and lives are at stake?

I have said that editors of newspapers were in a manner also to blame, for in misdirecting their censure, they have misled the public. Such is the case, for if, instead of execrating steamboat racing, and abusing such as have charge of boilers that have *exploded*, they were to publish the Owner or Director of the boat, together with an authenticated account of the affair, public enquiry would be led into the right channel, and beneficial results must follow; or if they were to make some enquiries themselves, they would find that there are several lines of steamboats, both in the Northern and Western waters, on board of any one of the boats composing which, an explosion of a boiler has never taken place; and in pursuing their enquiries still farther, they would find that these boats have been run under the direction either of engineers, or persons possessing the requisite qualifications for such a duty.

Again, I have said that steamboat racing, so far from being the cause of explosions, is a reasonable, if not a sure guarantee of safety. Strange as this may appear, it is yet true. When engineers are "driving" their engines, they must have an unusual pressure of steam to effect it, and to obtain which almost incessant "firing" is necessary; the firemen are constantly in the fire-room attending to the boilers, their hands and eyes are flying alternately to the gauge cocks, steam gauge, and furnaces; the height of the water is momentarily watched, and any defect in the boiler or its dependencies is immediately discovered. Thus ample time is afforded to institute such remedies as occasion may call for, added to which, the anxiety of the engineer leads him to a constant supervision of all connected with his department. And, as it is asserted by many very able engineers, and with some truth too, that it is impossible to *burst* a boiler with the due quantity of water in it, and the engine in full operation, little danger is to be apprehended from this source; the reason alleged is, that boilers, properly built, are not only capable of sustaining a much greater pressure than is ever generated in them, or sought for, but that it would be almost impossible, if not quite so, to raise a sufficient head of steam in the boilers, of the proportions of the past or present day, (I allude to American only,) to burst them with the engine in operation.

In reply to the question given in the first number, respecting the greater frequency of accidents to boilers in this country when compared with those of Europe, an answer is found in the difference of the temperature of the water, pressure of the steam, and the size of the boilers, together with the difference in the quantity of water "carried" in them. In Europe the boilers are much larger, and the water carried in them is nearly three times the quantity carried in those of this country, for engines of the same power; the pressure of the steam seldom exceeds 5lbs, to the square inch, usually 3½lbs. while with us 40lbs. are frequently carried, and less than 12lbs. is seldom used; I allude to the low pressure or condensing engine, as that is the only description of marine engine used in Europe, and the only kind as yet adapted for long voyages and sea water. The consequence is, that carrying less water, evaporation is more rapid; the level of the water is sooner depressed, affording less time for remedies, if a deficiency in it, or a defect in feeding is discovered; a greater deposition of lime, salts, and acids takes place, and the metal is more liable to be burnt; to guard against the effects of all of which, much greater risks than those of our transatlantic brethren, in consequence of the difference in the plan and operation of them; and if to arrive at the present efficient state of our engines and boilers, it is necessary to incur risks in the proportion of their superiority over others, there is but one course to pursue, and that is, with the risk, to increase the supervision and preventives.

Further, there are a sufficient number of young men in our country, of liberal education, intelligence, and natural mechanical abilities, if the proper incentive was held out to them, to make that their profession, a thorough knowledge of which guarantees them an enviable situation and a liberal support; in the prosecution of which, they would be of an inestimable service to the public at large; and in return would derive an ample reward, in the receipt of these advantages; added to which, our government has already employed some of the members of this profession in the naval service, and many more ere long will be required for similar duties, effecting not only a further demand, but adding a most honorable feature as well as character to the profession.

If, as I have advanced and can prove, *the steam engine of this country is years ahead of that manufactured in Europe, in every particular*, and as it is equally indisputable, that in naval architecture, and navigation, we have no superiors, why then should English steam vessels be allowed to supply that place which our merchantmen have so long and so proudly filled? Is it that we have not engineers sufficiently competent and discreet to take charge of their own work? No, rest assured such is not the case.

Then let American enterprise resume its mantle, and it will be found to assume its accustomed sway, in Atlantic as well as river steam navigation. A Great Western and a British Queen may excite some admiration this side of the water, but if a *Great Eastern* or an *American Eagle* does not ere long excite wonder and chagrin upon the other side of the water, then there is but little truth in the vaticination of A YOUNG ENGINEER.

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(Continued from page 230.)

## *Minutes and Proceedings of the Institution of Civil Engineers, containing Abstracts of Papers, and of Conversations for the Sessions of* 1837.

June 6, 1837.

The PRESIDENT in the Chair.

The subject of forcing air through pipes and of ventilation being resumed, Mr. Cottam stated a case in which a circular blowing machine, having a straight pipe 10 feet in length, and 6 inches in diameter, was sufficient to supply three furnaces, but that a single elbow rendered it incapable of supplying one.

Mr. Oldham, of the Bank of England, stated, that in all the attempts which he had made to effect any purpose, he always endeavoured to imitate nature. Now nature supplies a large quantity of air slowly heated. He had consequently established a stove with a very large heating surface, and a pump capable of delivering fifty cubic feet per stroke. To get rid of the foul air, he made large openings in the roof, and took care that there should be an abundant supply of air properly heated. The air is brought in at a temperature of 180° F.; thus there is a rapid change of air; and a summer heat is obtained without any sense of oppression. The success which had attended this system during two frightful seasons of typhus and cholera in Dublin, would be attested by many medical men; in the middle of winter he kept the doors and windows open, and threw in abundance of warm air.

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"On the Methods of Illuminating Lighthouses, and on a Reciprocating Light; by Capt. Smith, of the Madras Engineers, F.R.S., A.Inst.C.E."

In this paper, Captain Smith details the two different systems of fixed and revolving lights, which are generally adopted, and the objections to which each is liable. In the fixed light, the effect produced is precisely proportioned to the means employed, and none of the light is lost, since none of the reflectors are pointed inland; but in a revolving light, provided the revolution continues complete, part of the light is expended to no purpose. The revolving light is however necessary in many cases, since it is only by a series of flashes and eclipses succeeding in a determined order, that the particular lights on a thickly studded coast can be distinguished from each other.

As a means of obviating the objections to which each is liable, Captain Smith proposes, in places where lighthouses are not numerous, to stop the revolution of the apparatus after a certain portion of the circumference has been traversed, and then to reverse the motion so as to cause the light to reciprocate. The action of the reflectors is thus confined to the sea-side only. By this means, a light may be obtained at five-eighths of the expense usually incurred.

The paper is accompanied by a diagram descriptive of the mechanical contrivance for obtaining this alternating motion.

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## June 13, 1837.

The President in the Chair.

Mr. Oldham resumed the account of his system of warming and ventilating, and exhibited a model of his stove for heating the air. He was convinced that the expedient of forcing the air by mechanical means must be resorted to. He had raised the temperature of a room 24° F. in one hour; by a spontaneous ventilation he could never obtain a temperature of more than 100° F., but by pumping in the warm air he readily obtained a temperature of 150°F., or 180°F.

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Mr. Horne called the attention of the Institution to a lamp which he thought would be peculiarly applicable to lighthouses, or wherever an intense light is required. The usual burners are an inch in diameter;

now he had succeeded in producing a clear white light by a burner of half an inch in diameter. The excellence of the light is due to the complete combustion obtained by making the area of the external equal to the area of the internal apertures. The air thus passes directly to the burner; there is a perfect uniformity of draught, the rapidity of which may be regulated by the height at which the burner is above the bottom of the glass, or chimney. The draught of air being thus supplied with perfect equality to both sides of the wick, a flat and steady flame of two inches in height is obtained, and the force of the draught is sufficient to prevent the flame from touching the edge of the burner, so that the edge is always clean and fit for use.

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" A series of Experiments on the Elastic Weight and Strength of Cast Iron Beams; by Francis Bramah, M. Inst. C. E."

This very extensive series of experiments had been undertaken several years ago, with the view of verifying the truth of the theory of Bernouilli, Young, and Tredgold, with respect to the equality of the forces of extension and compression in cast iron within the elastic limit. The experiments are accompanied with a paper fully explaining the method in which they were conducted, and with a drawing of the proving machine.

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" A practical Method of forming the Stones of an Elliptic Arch; by William Bald, Civil Engineer, F.R.S.E.; M.R.I.A."

In presenting this paper to the Institution, the author has no object in view but to leave a record of the proceedings of an operation successfully carried into execution more than seventeen years ago. This consists in the application of the well known property of the elliptic, 'that the lines from the foci make equal angles with the tangent at any point.' The moulds are thus traced out by drawing a few straight lines.

This plan was adopted in the construction of a bridge over the Owen-More river, in the west of Ireland; and a model of the two courses of the cutwaters of this bridge was presented to the Institution. In these courses the stones are cut so as to break joint with each other, and the blocks are connected together into one course after the manner so ingeniously devised in the construction of the Eddystone.

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The meeting of the Institution was then adjourned to the second Tuesday in January, 1838.

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## *Steam Ships of War.*

THE miserably exposed condition of our coast to the attacks of foreign armed steam vessels has been already remarked upon by us. To what an extent the seaboard may be ravaged by them, can be judged from a glance at the present strength of Great Britain in that way. That power has the following named steam vessels:

*Of the First Class*—The Cyclop and the Gorgon.

*Second Class*—The Dee, Medea, Rhadamanthus, Phœnix, Salamander, and Messenger.

*Third Class*—Hermes, Firebrand, Firefly, Megara, Spitfire, Volcano, and Flamer.

*Fourth Class*—Blazer, Tartarus, Columbia, and Pluto.

*Fifth Class*—Lightning, Meteor, Confiance, Echo, Albion, Carron, African, and Comet.

Total, twenty-seven!!

Now it will be remembered that these were built, or in active operation, before the experiment of navigation across the Atlantic by steam was determined. That trial being now satisfactorily consummated, the immediate policy of the British Government will be to multiply her armed steam vessels so as to render her force in that capacity consentaneous to the new order of things; and the attitude of Canadian affairs will doubtless expedite her determined action on the subject. France, too, will have her floating armament, multiplied; she has already a bold nucleus to work upon. As a wise and prudent people, we should accommodate ourselves to this new national position. We should not be behind the age in this improvement, much less should we be blind to our safety. An enlightened Congress owes it to the nation to take the earliest steps for the protection of our coast. If the frame work of a dozen steam vessels were laid at once, so much the better. We should not count for the continuance of peace on the forbearance of foreign nations, but on ourselves being prepared for war. We are now in a deplorable state should that calamity occur:—an exposed coast; commerce most lamely protected by a meagre naval force; and seventy thousand savages ready to unbury the hatchet and pounce down on undefended settlements and imperfectly organized forts.—*National Gazette.*

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*Anecdote of Steam Navigation.*—A smart dapper little fellow, with a pattern book under his arm, called in at one of our large carpet warehouses: "I have come, sir, for some orders—here is my pattern book, should be happy to serve you." The proprietor, after turning over the leaves, said to the agent, "Will you have the goodness to leave this book for a day or two, and I will send it to your lodgings." "Bless you, sir, I have no particular lodgings; I arrived in the Great Western, took with me a valise and six clean shirts, only used three on the passage. I have run about from store to store until I have received orders for one thousand pieces of Brussels carpeting; you are the last person I have called upon. I am constantly on my feet—I dine when I am at leisure at any eating house that is nigh, and I pay for my lodging at night—so I have really no settled habitation. I must return in the Great Western to-morrow, as I have been absent from home when I get back full *forty* days—you are the last I have to call upon, and any orders you may please to give me, can be executed and sent to you complete in *six weeks* from this time per steam ship." Commentary is useless—this travelling agent in 24 days from the time he left home, received orders for $100,000 of carpeting.—*N. Y. Eve. Star.*

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*Canal Enlargement.*—We learn by the Lockport papers, that the decisions on the proposals for rebuilding the combined locks, rock excavation, &c. were to be made known last evening. The Democrat and Balance says:

We understand that over *one hundred and fifty* propositions have been received for the work embraced in the notice. A large number of applicants for jobs are in attendance, and as may be inferred from the number of propositions, there has been much competition for the work.

### *New-York and Albany Railroad.*

In Number 7—from an error in printing, and mistake in a word—it would appear that on this road one-tenth of the distance is on a grade *exceeding* 30 feet per mile, whereas no portion of the road exceeds 30 feet per mile. The sentence should read :—

The entire distance from Harlaem River to Albany will be *less* than one hundred and fifty miles, and upon a grade not exceeding 30 feet to a level; seven-tenths will be level or under 20 feet; two-tenths will range from 20 to 29 feet; whilst only one-tenth in different places need *equal* 30 feet; with moderate cuttings and embankments.

The heading on the second and third pages of the Report reads New-York and *Erie*, instead of New-York and *Albany* Railroad.

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*Baltimore and Ohio Railroad.*—A meeting of the Stockholders of this company was held yesterday, which adjourned over to the 19th December next. The reasons for the adjournment were stated by the president, and met with the entire approbation of the meeting. Of one thing we were fully satisfied, that every effort is being made to remove the obstacles in the way of the prosecution of the work, and that these are gradually and certainly yielding to the exertions of the able head of the Company. The road passes through three States, upon the legislation of all which it is dependent, and is affected, as may readily be supposed, by various and often conflicting local interests—to accommodate, conciliate, or overcome which, necessarily requires patience and time. We felt satisfied, yesterday, however, that it would not be long before the work would be recommenced with a clear field before it, and with a certainty of being pushed forward to completion. It is one that involves many difficulties, and the best guarantee of its seccess will be found in the cordial and unanimous support of the community.—*Baltimore American.*

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*Railroad Speed and the Mails.*—In our paper of yesterday we stated that the great London and Birmingham railroad was completed and thrown open on the 17th ult. and that the distance, 112¼ miles, was traversed in four hours and a half.

At this rate of speed, *and it is moderate and safe on a well constructed road*, the distance between this city and Albany can be traversed, on the construction of the New-York and Albany railroad, in five hours and a quarter, and by the Massachusetts railroads to Boston, within eleven hours.

This experiment fully sustains the Commissioner and Executive Committee of the New-York and Albany Railroad in the opinion advanced by them some time since, " that the United States Mail could be carried on that route in six or eight hours to Albany, and in twelve hours to Boston, and for this facility the general government should pay at least $50,000."

We cordially agree with them even were the sum doubled. The advantages of steam on railroads has not been fully considered. A man, at this rate, will take his dinner in Albany and return to tea, with perfect safety and certainty. At the rates which have been traversed on several railroads in this country, it may be accomplished in half the time, when Express speed is required.—*N. Y. Times.*

AMERICAN

# RAILROAD JOURNAL,

AND

# MECHANICS' MAGAZINE.

No. 9. Vol. I. New Series.] NOVEMBER 1, 1838. [Whole No. 321. Vol. VII.

## *Ketchum's Patent for enabling Locomotives to ascend Inclined Planes.*

WE have examined the model of Mr. W. D. Ketchum's Wheel and Rail, at present in this city. The inventor claims, as its chief advantages, simplicity of construction and saving of time.

It consists simply of a wheel with a wedge-shaped groove, fastened outside of the driver and on the same axle. These wheels are smaller in diameter than the driving wheels, and the dimensions are regulated by the inclination to be overcome.

When the Locomotive reaches the foot of the inclined plane, the outer wheels run upon a rail prepared to receive them, and which is raised so much above the other rail as just to clear the usual driving wheels from it. It must be evident, in this case, that the gain of power is in proportion as the outer wheel is smaller in diameter than the usual driver.

The inventor conceives that the peculiar shape of his wheel promotes adhesion, so that the gain in power is not lost by a slipping of the wheels.

It is very evident that any means for overcoming high grades without assistant Locomotive power, must add materially to the capability of Railroads, and admit of their being constructed in situations, whereas without such means cutting to a lower grade would be impossible, and the road impracticable.

The inventor possesses the testimonials of many engineers as to the usefulness of his invention. It appears that calculations have been made showing an immense gain to the Erie Railroad, and other companies, from the use of this contrivance. Certainly a matter of so much importance should speedily be put to the test of a trial on a large scale.

### *Important to Railroad Companies and Car Builders.*

Mr. P. Alverson, of New Haven, Conn., has lately invented a new and useful improvement in the mode or method of attaching Railroad Cars to each other, and to the moving power, of which we are in hopes to give a more full description in our next number. The object of his invention is to prevent the jerk usually experienced on the first movement of the Cars, and the jar occasioned by the concussion when suddenly stopped. He has also, in addition, constructed a Connecting Link in such a form so as to keep the Cars in a regular motion each way, and do away with the bumpers, so called, to save much cost and expense. This Link is also constructed, so that when one Car is thrown from the track, it will disconnect, and not take any more with it. From what we have seen and heard of his improvement, (which he is now applying to the Hartford and New Haven Railroad Cars,) we think it a valuable improvement for the benefit of the Locomotive Cars, and safety of passengers, and would recommend it to all Railroad Companies and Car Builders. It costs but little (compared with the benefit of it, and safety to passengers) for each Car; it is easily applied, and not liable to get out of order. His intentions are to visit the different Roads in the United States with a sample of his improvement, and hopes it will meet the approbation of all concerned in Railroads.

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### *Atlantic Steam Navigation.*

We put on record the following notice from our daily papers, conceiving that it is the commencement, under auspicious circumstances, and in the right way, of an undertaking likely to prove as profitable as creditable to the country.

We have been surprised that something of the kind has not been done before, but the truth is, we are so inclined to boast of our peculiar advantages, that we often suffer them to lie neglected. The success of such an enterprise, properly undertaken and skilfully conducted, is as obvious in a professional as in a mercantile point of view.

We wish all manner of success to the first *American Atlantic Steam Navigatiion Company.*

An adjourned meeting was held at the Carlton House on Thursday, the 16th October, to receive the report of a Committee appointed at a previous meeting, at which James Boorman, Esq., presided, on the subject of Atlantic Steam Navigation.

J. DePeyster Ogden, Esq., was called to the chair, and Archibald Gracie, Esq., appointed Secretary.

The report of the committee adverted to the highly successful results which had attended the incipient steps of this great enterprise, both in a scientific and commercial point of view, as affording increased facilities of intercourse by a more speedy and definite mode of communication than had hitherto been accomplished, even by the excellent lines of packet ships, which have been so long and so deservedly in successful operation.

Among other views presented by the Committee it was submitted as their opinion, that if a regular intercourse by means of steam had existed between the United States and Great Britain two years ago, most of the difficulties and disasters of the late commercial crisis might have been greatly mitigated, and many perhaps, altogether prevented.

A statement of the large profits to be derived from such an enterprise was submitted to the meeting by the committee, showing that in calling on their fellow-citizens, to unite in the accomplishment of so beneficial a result, their expectations of success were not founded on theoretical calculations, but on those derived from practical experience.

The following resolutions were then unanimously adopted :

Resolved, That it is expedient to form a Company in this city, to be called the "American Atlantic Steam Navigation Company," and to obtain an act of incorporation, with a view of building a steam ship or ships to navigate the ocean.

That the interests of this State and City, and the maintenance of that high standing for commercial energy and enterprise which has hitherto characterized it, call loudly upon our citizens, whose waters were first successfully navigated by steam, to assist in applying this immense engine of power to the navigation of the ocean.

Resolved, That a Committee of twelve be appointed to obtain subscriptions and further the objects in view, and that they be authorized to call a meeting of the subscribers at such time as they may deem expedient.

Resolved, That the following gentlemen compose the Committee :

| | | | |
|---|---|---|---|
| Jas. D. P. Ogden, | Esq., | Capt. James Rogers, | |
| John H. Hicks, | " | Henry Smith, | Esq. |
| Archibald Gracie, | " | Moses Taylor, | " |
| James Boorman, | " | Hamilton Murray, | " |
| Elihu Townsend, | " | Robert Schuyler, | " |
| James Lee, | " | Joseph Fowler, | " |

Estimates of the cost of a steamer of 2000 tons and upwards, with machinery complete, to be constructed at New-York, were laid before the meeting, and subscription lists with the following heading have been prepared and are in the hands of the Committee :

ATLANTIC STEAM NAVIGATION.

The subscribers hereby declare their readiness to take stock to the amount opposite their names respectively ; in shares of $500 each, in a company to be incorporated in the city of New-York, for the purpose of navigating the ocean by steam, in pursuance of the proceedings at a meeting held on the 16th day of October, as published in the daily papers of the 27th inst.

Dated New-York, 27th October, 1838.

J. DePeyster Ogden, Chairman,

*Archibald Gracie*, Secretary.

## *New-York and Albany Railroad.*

"We observe the appointment of *Edwin F. Johnson, Esq.*, as Chief Engineer on this road. This appointment is indeed auspicious of success. Mr. J.'s abilities are well known in this part of the State, which derived no small advantage from his skill both as an Engineer, and as a lucid and vigorous writer. Mr. Johnson's professional rank is now among the first Civil Engineers in the United States. He has probably no superior. His connexion with the New-York and Albany Railroad will greatly contribute to the establishment of public confidence, and we shall rejoice to see the work in a course of actual prosecution."—*Oswego Palladium.*

We most cheerfully give our assent to the above tribute to the talents of Mr. J., and heartily congratulate the New-York and Albany Railroad Company on having secured the services of a gentleman so distinguished in his professional reputation, and by his appointment the still higher regard of the public, already sternly in favor of this important work.

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## *Hiwassee Railroad.*

Knoxville, Tenn. September 25, 1838.

Gentlemen—The grading of the Hiwassee Railroad is progressing rapidly. Owing to our isolated position, the derangement of the money market has had comparatively but little effect upon us, having at no time obliged us to suspend, or even materially to contract, our operations. The whole extent of the road from Knoxville to its connexion with the Georgia Railroads, at the division line of Tennessee and Georgia, (98½ miles) is now under contract. Nearly the whole of it has been taken by Mr. Kennedy Lonergan, a well known northern contractor; and it affords me much pleasure to add mine, to the many certificates he already possesses, of ability, energy, and faithfulness in his business. Our operations are just now confined to the 41 miles of road lying between the rivers Tennessee and Hiwassee; which will probably be ready for the rails this winter. The lower 25 miles of the road. being that portion which extends from the Hiwassee River, at Calhoun, to our junction with the Western and Atlantic Railroad of Georgia, at the Georgia State line, lies entirely within the Cherokee Country The occupation of this district by the Cherokee nation, now concentrated there for removal, and by the military forces under General Scott, who is directing the removal, has so increased the scarcity and prices of provisions, that it is impossible for the contractor to procure subsistence for his men. The energetic measures of General Scott, will, however, in a few weeks relieve us from that impediment, and enable me to put heavy forces to work along that portion of the line. I expect to have 66 miles, extending from the Georgia line northward, ready for the rails. within twelve months from this time; and as Colonel Long will have, *at least*, an equal extent of the Western and Atlantic Railroad finished from the same point, southward, we shall have completed a continuous line of 132 miles; by which means both roads will be rendered available much sooner than they could otherwise be.

From the lower termination of the Western and Atlantic Railroad other Railroads are in progress by which, within three years, we shall have opened direct communications from Knoxville to Charleston, Savannah, Mobile, and New Orleans. These several lines present the unprecedented fact of *more than* 600 *miles of connected Railroads, no where encumbered by grades exceeding* 36 *feet to a mile; nor by a single curve, of a radius less than* 1000 *feet; and at the same time entirely free from tunnels and inclined planes.* No portion of this immense extent of Railroad is liable to interruptions from the frosts, snows, and ice of winter; therefore, *even on the most objectionable parts*, a good locomotive will, with ease, draw as its usual load, 150 tons of freight, or 500 passengers; and with these loads the entire chain may be travelled with no other limitation of speed, than what experience has shown to be conducive to safety, and to the preservation of the road. Fortunately, too, each separate road has the same maximum grade (differing on none I believe more than 3 or 4 feet); from which circumstance, a wonderful regularity of business may be maintained. There is scarcely a doubt, that the Legislature of Virginia, will at its next session, authorize the construction of a Railroad from Richmond to the Tennessee line, near Blountville; if so, Tennessee will continue the Hiwassee Railroad northwardly, to the same point, a distance of but 125 miles; and then will be effected the "consummation so devoutly to be wished for"—*a continuous Railroad from Boston to New Orleans.* I am, very respectfully, yours, &c.

John C. Trautwine.

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*Second Annual Report of the President and Directors to the Stockholders of the Louisville, Cincinnati and Charleston Railroad Company—September*, 1838.

In submitting their second annual report, the Board are gratified in being able to state that they have accomplished most of the objects to which their attention was directed by the Stockholders, at their general meeting in October last. The Charleston Railroad, which they were instructed to purchase, has been obtained on the terms proposed—that is to say—at 25 per cent. advance on the first cost of the shares—the purchase money being payable, one-third in cash, and the balance in one and two years. The sum agreed to be paid for this road does not exceed its actual cost to the Stockholders, or its value to us. By this purchase, we have secured a road, *ready made to our hands*—136 miles in length, extending from Charleston to Hamburg, on the Savannah river—opposite to Augusta in Georgia, where it meets the Athens Railroad, through which it will finally be connected with all the improvements now going on in Georgia and Alabama, and thus command to a very great extent the trade of the South and South West. The Charleston and Hamburg Railroad is undoubtedly destined to be *The Great Highway* between the North and the South, and South West. By means of the Wilmington Railroad, extending from Wilmington in North Carolina, to Halifax on the Roanoke river, of which upwards of 60 miles are already completed—a continuous line of Railroad and Steamboat communication will be furnished from Wilmington to Boston. By this route, a traveller leaving Charleston, will be able to reach Washington in two days, New-York in three, and Boston in less than four days. To travel from Augusta in Georgia to New-York, a distance of 800 miles, will require no more than four days; and when the projected Railroads in Georgia and Alabama shall be completed, it will be entirely practicable to travel from the Gulf of Mexico, or even New-Orleans, to Boston in less than a week.* The Charleston and Hamburg Railroad will constitute one of the most important links in this line of communication, and if, with its present limited connexions, upwards of 100 travellers are conveyed upon it daily, and its daily receipts exceed $1,000, we may reasonably anticipate, that the time is not distant, when these will be increased to an extent which will exceed any calculation we would now venture to make. To our Company, however, the purchase of the Charleston and Hamburg Railroad, was even more important than this view of the subject would indicate. The Stockholders had decided that a grant of banking privileges was indispensable to the success of the great enterprize, and liberal charters had accordingly been obtained from the States of North and South-Carolina. These, however, had been granted on the express condition that *three States* should concur therein, *and*, that the subscription to the Road should be increased to eight millions of dollars, on or before the 31st of December, 1837. At the meeting of the Stockholders in October last, the whole subscription amounted to about $5,300,000; and in order to secure the Bank Charter, it was necessary that either Tennessee or Kentucky should be induced to concur in the grant, which had been made by the two Carolinas, and *also*, that $2,700,000 should be added to the subscription before the end of December. The President having repaired to Nashville, obtained the consent of the Legislature of Tennessee to the Bank Charter, (though the application to Kentucky unfortunately failed,) and also procured a subscription on the part of the State of Tennessee to the amount of $650,000. But still upwards of *Two Millions* of dollars remained to be subscribed in the short space of three weeks, which could not possibly have been obtained in any other way than by the purchase of the Charleston and Hamburg Railroad, which was made on the condition that a subscription should be made in behalf of the Stockholders in that Company, for 20,000 shares in our Company, the first payment on which was to be deducted from the purchase money. This left a deficiency of only $50,000; which was promptly, and liberally made up by the city Council of Charleston; and *the Bank Charter was thus secured*; which confers upon the company privileges of such inestimable value, that no doubt can be

* That these calculations are not extravagant, will appear from the following statement. By the Steam Packet Boats leaving Charleston at 5 o'clock, P. M., passengers are enabled to reach Wilmington the next morning to breakfast. From Wilmington a Railroad has been laid out, and is now in a course of rapid construction, to Halifax on the Roanoke River, a distance of 160 miles. Of this, 60 miles are finished and in use; and it is expected that in December there will be 110, when but 50 miles will remain unfinished. When completed, the distance will probably be run in 10 or 12 hours. At Halifax, we find two Railroads, one extending to Norfolk, and the other to Petersburg, Va. At Petersburg we fall upon the Railway extending through Richmond to Fredericksburg. Here we travel, *at present*, in stages 9 miles to Potomac Creek, though it is in contemplation immediately to extend the Railroad to the Potomac, at or near that point. Here we take a steamboat to Washington, which is reached in five hours, and will be reached in half that time, when the Fredericksburg Railroad shall be extended to Alexandria. Leaving Washington at 6 o'clock in the morning, we may even now actually arrive at Boston by 8 o'clock the next morning—a distance of 400 miles. We reach Baltimore in two hours and a half, arrive between 12 and 1 o'clock at Philadelphia, in time to take the New-York cars or steamboats, which arrive at that city by 6 o'clock the same evening. There, by going immediately on board of the steamboat for Stonington, we are carried to that place by 3 o'clock next morning, where by the Stonington, Providence and Boston Railroads, we are enabled to reach Boston by 8 o'clock, making in all 26 hours from Washington. Such are the facilities afforded by Steamboats and Railroads on these routes, facilities which will be greatly increased, should a Railroad be extended from Wilmington to the Waccamaw river, and from Georgetown to Charleston.

entertained, that under a judicious management they may be made to yield full dividends on the whole investment, both in the Road and the Bank,—furnishing at the same time the means for making the Road. We know that this has actually been effected in an adjoining State, through the instrumentality of a State Bank of very limited capital and circulation—what may we not expect therefore from an Institution incorporated by three or four States, and a circulation at least co-extensive with their limits? But these were not the only advantages to be secured by the purchase of the Charleston Railroad. That Company enjoyed the exclusive privilege of making a Railroad from Charleston to Columbia (which, however, they were not yet prepared to execute,) and difficulties were apprehended in the attempt to form a junction with them—difficulties which had been experienced elsewhere under similar circumstances, and which were forcibly presented to the Stockholders at their last general meeting, in the "Report of the Committee of Thirteen." To obviate all of these difficulties—to secure to ourselves the valuable privileges of the Charleston company, and at the same time to obtain possession of a Road already made, and not only valuable in itself, but especially valuable to us, as furnishing for upwards of sixty miles from the seaboard, a Railway of which we could avail ourselves in the extension of our Road through the centre of South-Carolina, thus forming the first great link in the proposed connection between the South and the West—were objects of the last importance. Availing ourselves of these advantages, the Board of Directors have, since the purchase, caused the Road to be located (in the construction of which great progress has been already made,) from Branchville,) a point on the Charleston Road, 60 miles from that city,) to Columbia, the Capital of South-Carolina, from which place it is proposed to extend our *main trunk*, through the centre of South-Carolina, across the Butt Mountain Gap in North-Carolina, and thence along the valley of the French Broad River, to Knoxville, (Tenn.) from whence it will be carried to Lexington, Kentucky, and eventually, we trust, to the Ohio and Mississippi Rivers--by as many routes as the interests and the convenience of the people of the Western states may require. Though several routes have been surveyed between Columbia and the Mountains, and also between Knoxville and Lexington, all of which have been found entirely practicable; it has not been deemed proper to proceed to the *location* of any part of the Road above Columbia. As a general principle, it is deemed wise and prudent to progress step by step from the sea coast towards the interior, and not to attempt simultaneously the construction of detached and independent sections. which would be comparatively useless until the whole is completed. Nothing, it is believed, would tend more directly to impair public confidence in the success of our great enterprize than the attempt to commence operations at once along the whole line. In all great undertakings the concentration of force upon a few points, has been found to produce the most decisive results; and we believe that the experience of every state in this Union, has proved that failure has generally attended those schemes of internal improvement, which have been conducted on the principle of attempting to conciliate all interests, by prosecuting at the same time, with limited resources, an extensive system of Roads and Canals, embracing complicated and diversified operations. In our case, this danger was intended to be guarded against by a provision of the charter, that the funds subscribed in any state should, at the discretion of the Directors in that state, be first applied to the construction of the Road within the limits of such state. As therefore the funds subscribed in the other states, could not be applied to the making of the Road in South-Carolina, no objection could exist on the part of those states to the plan adopted, of proceeding step by step, from the ocean towards the mountains—which is the only safe and practicable scheme; and it was taken for granted, that in none of the other states could the Directors consent to any application of their own funds, but such as would in every possible event enable them to reap the fruits of their expenditures. By adhering to this plan, instead of expending vast sums of money on detached portions of the Road, from which no income could be expected, until the whole work was completed, we shall be enabled, with comparatively limited expenditures, to *finish and bring into use*, successive links in the great chain of communication—thereby furnishing, at every step, additional inducements for the further prosecution and gradual extension of the work. By pursuing this system, aided by the bank, we may hope, in a short time, to give to all our Stockholders full dividends on the capital invested, with the prospect of a regular increase of the dividends as the Road may advance—whereas by commencing operations simultaneously at detached points along the whole line, no such results could be expected, while the constant demands upon the Stockholders for carrying on such extensive operations, would serve to discourage them, until seeing no prospect of immediate returns, they might be tempted to forfeit their stock, and abandon the enterprise in despair. In further illustration of the advantages of the system here recommended, we would suggest, that it seems to give the best possible security for the eventual completion of our great work. When the Stockholders shall clearly perceive, that we are proceeding on a plan which must render profitable whatever sums they may invest, they will have the strongest inducements to comply with all the requisitions that may be made upon them. When one section of the Road shall be finished, and brought into successful operation, a sure foundation will be laid for the construction of the next, and thus we shall advance step by step, and as rapidly as our means may permit, to the final consummation of our work, securing, as we progress, the fruits of our enterprize. Let us suppose that, proceeding on this principle, the Road shall in a short time be extended from Charleston to Columbia, and be put in successful operation for a distance of 128 miles. Encouraged by this success, the company would certainly be anxious to extend it from that point across the mountains, while the people living in the intermediate districts, would naturally strain every nerve to effect this extension as soon as possible. We are perfectly satisfied that they would, if necessary, by their own unaided efforts, make this portion of the Road. *Once carried across the Mountains, the Road will make its own way.* We may safely rely upon the citizens of North-Carolina, Tennessee and Kentucky, aided as in the end they must be, by their respective states, for the gradual though certain extension of the Road to the Tennessee and Ohio rivers, whenever the work shall be brought within their reach. When, by the construction of a comparatively short section of the Road, within their own limits, the people of any state shall find that they can avail themselves of a continuous line of Railroads to the Atlantic ocean, and that too by the *shortest and cheapest route*, the ordinary principles which control the action of communities as well as of individuals, must have lost their influence, should they *then fail* to put forth the efforts necessary to secure this inestimable advantage. We are satisfied, therefore, that the first step in our great enterprize, viz: the successful execution of the work now in a course of construction between Columbia and Charleston, will, (with the possession of the Charleston and Hamburg Railroad, and the establishment of the Railroad Bank) ensure, in the end, the extension of the Road to the navigable waters of the West. At every stage in our progress, however, let our eyes be constantly fixed on this extension, as the consummation of our great work. Let us never forget, that to bring the South and the West together, is the end at which we aim, and while proceeding gradually, let us advance steadily toward that object, firmly resolved to do all that may be in our power, for its certain and speedy accomplishment. Let the bank be at once established, with branches in North Carolina and Tennessee, and let our whole course of conduct manifest a fixed determination on the part of the Stockholders in all the states to act harmoniously together—governed by common councils, directed to common objects—and, under the influence of enlightened and liberal views, pressing forward in full confidence that a wise policy steadily pursued, will, in the end, crown our labors with triumphant success. We do not wish to be understood by any thing we have here said, as intending to discourage the commencement of the work, in any of the other states, at points where there may be sufficient reason to believe it can be completed, within a reasonable time, and where, when finished, it can be rendered useful and profitable of itself. These are points that must be left to the judgment of the Directors and Stockholders in each state. But whenever and at whatever points such works may be commenced, it is deemed important that the principles above indicated, should be observed in their prosecution, and that the rule should be invariably adhered to of husbanding our resources, and making our foundation sure, before we proceed to erect the superstructure.

In looking to our resources for carrying on this work, it should be borne in mind, that the purchase of the Charleston and Hamburg Railroad must necessarily consume a large portion of our funds for some time to come; and if at the expiration of one or two years, from the commencement of the enterprize, we shall have accomplished no more than to have paid for that Road, and constructed our main stem to Columbia, more will then have been effected, than has ever been performed in this or in any other country, by any single company in the same space of time. We shall then be in possession of a Railroad *two hundred miles in extent*, twice as long as any single Railroad now existing in the world, and which will have been completed in half the time usually occupied in such works. To accomplish this however, will require the exertion of our best energies—the calling into requisition all our resources, and the application of all our means.

It has been shown, that the price of the Charleston Railroad was $2,-400,000, of which $1,600,000, will have become due by the 1st of January next. In addition to this, the completion of the repairs and improvements on that road, including the embankment and new iron repairs of engines, cars, &c., may be estimated at about $300,000. The construction of the Branch at Columbia, on the most approved plan, will cost (as estimated by the chief engineer,) $1,500,000, making in the whole $4,200,000, for a considerable portion of which, provision must be made in the course of the ensuing year. The Directors, in carrying into effect the instructions of the Stockholders, for the purchase of the Charleston and Hamburg Railroad, were so fully aware of the impracticability of making calls, for the amounts necessary for that object, that they resolved not even to attempt to make the purchase, (essential as that purchase was to the accomplishment of our objects,) unless the guaranty of the state of South Carolina, could be obtained for a loan of two millions of dollars. This, however, having been fortunately secured, it was believed that the purchase might be safely made. Should Gen. Hamilton, who has been sent as our agent to Europe, for that purpose, be enabled to effect this loan, as is confidently expected, we shall then have at our disposal the following means to meet our engagements, and to carry on the work, viz:

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| Amount of the first loan, - - - - - - | $1,000,000 |
| Balance of cash on hand, (according to the Treasurer's Report,) - - - - - - - - - - - | 150,000 |
| Making together the sum of, - - - - - - | $1,150,000 |

This sum will be applicable in the first place, to the payment of $350,000, due to the Banks in Charleston, being one half of the amount borrowed from them, to meet the cash payment on the purchase of the Charleston Railroad. There will also be required to meet the contracts for the construction of the Road between Branchville and Columbia, and the other current expenses of the company, up to the 1st January next, about $100,000, to which about $80,000 may be added for carrying on the repairs and improvements on the Charleston Road, the surveys, &c., up to the same period, making in the whole, $530,000; which being deducted from the means at our disposal as above, would leave a balance on the 1st of January next, of $620,000, which would be applicable to the payment of the 2d Instalment of $800,000, (with interest on the whole debt,) which will on that day become due to the Stockholders of the Charleston and Hamburg Railroad Company, amounting in the whole to about $900,000. It will be perceived then, that there will be a deficiency of near $300,000 of the amount necessary to meet our engagements on the 1st of January. This amount can only be supplied by calling for another instalment on the stock, or by making a temporary loan, until the 2d million can be obtained from Europe. Should Gen. Hamilton succeed in making a conditional arrangement for this loan, the money cannot be obtained according to the terms of the Act of the South-Carolina Legislature, until another instalment shall be called in from the Stockholders. This may be safely done in the spring of the next year, provided the Bank can in the mean time be put in operation. It is not believed, that it would be expedient to make any further calls upon the Stockholders until, by the establishment of the Bank, a fixed value shall be given to their stock. A temporary loan, therefore, to meet the demands upon the company, which will become due on the first of January next, seems to be the best expedient that can be devised. We can offer as security for such a loan ten thousand shares in the Charleston and Hamburg Railroad, whose par value is *one million of dollars*, which shares are now pledged to secure the payment of the $800,000, due in January next, but which will be released on the payment as above proposed of that sum, with the interest on the debt. It may be hoped that no serious difficulties will be experienced in effecting a loan of so much money, as we may require, say $500,000, on this unquestionable security, and if so—we shall have on the 1st of January next, a balance of $200,000, after paying all demands, and which will be applicable to the general purposes of the company. In extending our views still further, to the entire operations for the ensuing year, it will be found indispensably necessary that an instalment of $5 on each share should be called for early in the course of

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| that year. This we may assume to amount to | | $300,000 |
| The second loan, which may then be effected, will amount to | | 1,000,000 |
| Making together, | | $1,300,000 |
| The balance of the debt now due to the Bank must be paid, say | $350,000 | |
| The temporary loan above mentioned, must also be paid, say | 500,000 | |
| Making together, | $850,000 | 850,000 |
| Which deducted from the above, would leave a balance on hand of | | $450,000 |

On these payments being thus made, we shall moreover be left in possession of ten thousand shares in the Charleston Railroad company, worth at least a million of dollars free from all incumbrance, which, with such additional instalments as may be called for from the Stockholders, will constitute the means for carrying on the work—and would be adequate to that object. When the repairs and improvements on the Charleston Road shall be completed, we may reasonably expect to derive an income, from that source, but this must of course be divided among the Stockholders, and cannot be diverted to any other objects. It may not be necessary at present to look to any other resource, than the additional 10,000 shares, mortgaged to the Stockholders of the Charleston Railroad company, to obtain the means of paying the 3d instalment, which will become due on the 1st of January, 1840. But to carry on the work to the extent proposed, so as to finish the road to Columbia, early in 1840, will require a call for two or more instalments in the course of the ensuing year. Should our Bank, however, go into successful operation, no difficulty need be apprehended, from making the necessary calls, especially when the amounts called for, will be applied to securing a valuable Railroad property, to be put to immediate and profitable use, and from which dividends may be soon expected. Indeed, it could hardly be doubted, that the establishment of the Bank, and the completion of the Road to Columbia, with the possession of the Charleston Railroad, will lay a sure foundation for the entire success of our great enterprize. We will not even anticipate as probable, the failure of our negociations for a loan of two millions of dollars in Europe. We know that this important negociation has been entrusted to able and faithful hands, and therefore have every reason to rely with entire confidence on the success of an application made by a company incorporated by four states, under the guaranty of the state of South Carolina, whose credit is certainly equal to that of any state in the Union. In the calculations and statements above submitted, we have not aimed at minute accuracy. It is sufficient for our purpose to give the Stockholders a general view of the financial condition of the country—of our resources, and prospects, and the measures necessary to be adopted for the successful prosecution of the work. The Report of the Treasurer, and the chief Engineer, will furnish all the details that may be required.

But we consider the establishment of the RAILROAD BANK, as *the bond* which will serve to hold the Company together, and afford a certain resource in every time of need, and therefore as essential to the success of our great work. In this view of the subject, we would call the attention of the Stockholders to some of the leading provisions of our Bank Charter, and briefly point out the great advantages that may be derived from this institution, and the valuable uses to which it may be applied. The "*South Western Railroad Bank*" has been chartered by the States of North and South Carolina, and Tennessee, with a capital not to exceed *twelve millions of dollars*, and for a period of *thirty-one years*. Kentucky has not yet concurred in this charter, but strong hopes are entertained that the renewed application which is to be made to her Legislature, at the ensuing session, will not fail of success. We are strengthened in this expectation by the favorable disposition manifested towards our enterprize, at a recent meeting of the Directors at Lexington—by the small majority against the application, at the last session, of only six votes—by the deep interest which Kentucky has in the success of the Road—and especially in the establishment of a Bank, which will so essentially promote the trade and intercourse now carried on by her citizens, with the Southern States. But whether these expectations shall be realized, or not, it cannot be doubted that a bank, extending with its branches over three States, will furnish a currency which must be of inestimable value to the citizens of these States—a currency whose credit would be such as to command an extensive circulation, not only within the States granting the charter, but in the neighbouring States, and to some extent throughout the Union. Furnishing the ready means of transferring funds by drafts and bills of exchange, the South and West will be relieved from what is now felt to be an onerous tax upon their intercourse. This want of a common currency now subjects the trader and traveller, not merely to great inconvenience, but to much positive loss. Gold and silver, though indispensable as the basis of a sound circulating medium, never can, to any extent, be made available for the general purpose of commerce. No traveller or trader will attempt to cross the mountains with bags of specie, while he can obtain drafts or bank bills, which will answer his purpose equally well. In proof of this we will state the fact that on our recent visit to the West, we were unable to convert Southern bank bills, even of specie paying banks, into Western paper, except at a premium of 7 per cent, while Kentucky bank bills could not probably have been rendered available in Charleston without paying an equal amount—thus subjecting the holders of these bills respectively to a charge in a single transfer of funds between Lexington and Charleston, equal to a whole year's interest on the amount. Though this may be regarded as an unusual and extraordinary state of things, we feel warranted in stating, on the authority of several experienced Western traders—that the general condition of the currency, and of the exchanges, subjects the trade between the South and the West to charges which may be safely estimated at six per cent. on the whole amount employed in that trade, which we all know amounts to many millions annually. The South Western Railroad Bank will apply an effectual corrective to this evil. It will thus not only effect a vast annual saving to the traders and farmers of the South and the West, but by so doing will recommend itself to general favor and support, and if conducted on safe, sound, and liberal principles, will, at the same time, ensure large profits to the Stockholders. The failure to renew the charter of the Bank of the United States, has left the Southern and Western States in the condition above described, and from which they never can be relieved, but by the establishment of such a bank as ours. The New-York banks and the Pennsylvania Bank of the United States may furnish the Northern and the Eastern States with a currency sufficient for their parpose. But nothing short of a bank having a charter from several States, can supply our wants. The re-charter of the Bank of the United States must be admitted even by those who deem such measure most desirable, to be more than doubtful, and if it should take place at some future day, would come too late for our purposes. It is believed that from the South Western Railroad Bank, we may immediately realize most of the advantages expected to be derived frem a Bank of the United States, without interfering essentially with that Institution, should it be hereafter established. The history of the United States affords no parallel to our bank. Never before have three States concurred in granting any bank charter, and never has so liberal a charter been granted by any State. No bonus is required to he paid to either of the States. The stock, as well as the dtvidends thereon, are expressly exempted from taxation in the State of South Carolina, and substantially so in the States of North Carolina and Tennessee, and the bills of the bank are made receivable at the State Treasuries. While it is declared that the amount of the capital shall not exceed twelve millions, it is left entirely at the discretion of the Stockholders to fix the amount with which they may commence business, which amount they are permitted to enlarge, from time to time, as they may think proper. The only limitation in the exercise of this discretion, is found in the provision that after the two first instalments of $12½ each have been paid, the Directors of the Bank shall not call for any further sums, unless equal amounts shall be called for, on the Road. It will be seen, on referring to the charter, that in the present state of the subscription to the Road, (two instalments of $5 each having been paid,) the Stockholders will be entitled to hold bank stock equal to $30, on each share held in the Road, of which $12½ will be payable at the time of subscribing, and the remaining $17½ at such times as may be deemed advisable by the Directors of the Bank. At every subsequent call made for the Road, an equal amount may be called for in the Bank. A subscriber having paid ten dollars on his stock in the Road may therefore hold $30 of stock in the Bank, and at each successive call the amount of stock in the bank will continue to exceed the stock held in the Road by an equal amount, until the Bank capital shall amount to $6,000,000, when they must proceed together *pari passu* until they amount respectively to $12,000,000.

The object of this liberal provision, was to give income to the Stockholders while the Road was in a course of construction, and before any part of it could be made a source of profit. And this object may certainly be fully accomplished, if the Stockholders are only true to themselves. With $30 invested in the Bank, and $10 in the Road, *seven per cent.*, at least, may certainly be realized upon the whole amount of the investment, viz:—$40. Under successful management 10 per cent. can easily be made on the $30 invested in the Bank, which would be equal to 7½ per cent. on $40—the whole amount of the Stock held both in the Bank and the Road—and it is not doubted that as the operations of the Bank shall be subsequently enlarged, even greater profits may be derived, so as to keep up the dividends to at least 7 per cent., until the first division of the Road shall be finished, and brought into use, when the income of the Stockholder must be considerably increased.

Such are the important Banking privileges which have been conferred upon the Stockholders of the Louisville, Cincinnati and Charleston Railroad Company. No one is allowed to hold a share in the Bank who does not hold a corresponding share in the Road. The Bank, however, is to be managed by a separate Board of Directors, and neither the Stock nor the profits of the Bank are to be in any way liable for the construction or expenses of the Road—so that *the entire profits of the Bank must be divided amongst the Stockholders.* Under a resolution adopted by the directors, it is proposed to put the Railroad Bank in operation in November next. The resumption of specie payments by the State Banks, will render this comparatively easy. Books of subscription will be opened on the 2d Monday in October next, and continue open for one month, when every Stockholder in the Road, will be at liberty to subscribe for as many Shares in the Bank as he may think proper, not exceeding the number of Shares held in the Road. It is not doubted that the Stockholders will embrace the opportunity thus afforded of securing to themselves a valuable property, and at the same time of ensuring the success of our great work, which is inseparably connected with the establishment of the Bank. Even where the situation of the Stockholder might forbid his holding an amount of Stock in the Bank, equal to that for which he may have subscribed in the Road, a due regard to his own interests would require, that he should subscribe for the full amount to the Bank, and pay the first instalment of $12½. This will give an immediate value to his Railroad Shares, and he will be able to substitute others in his place on advantageous terms, and without injury to the Company—while a failure to subscribe to the Bank, would reduce the value of his Stock, and deprive him of the opportunity of availing himself of the benefits of the Bank at any future period. The Stockholders in the Bank will meet in person or by proxy, in Charleston, on the 20th of November, for the purpose of electing Directors, and it is proposed that the Bank shall go into operation as soon thereafter as possible, for which purpose the bills of the Bank of the various denominations are already in the hands of an engraver, and a temporary banking house will be provided. Branches will be established in Tennessee and North-Carolina, as soon as possible after the Mother Bank can be put in operation in Charleston.* We submit herewith the last semi-annual Report of the President and Directors of the Charleston and Hamburg Railroad Company, which affords satisfactory evidence of the great progress which has been made in the repair and improvement of that road, and of the steady increase of its business and income. It is known to the Stockholders, that this Road, of which we have now become the proprietors, was originally constructed on a frame work of wood, without any embankment, and that the Iron Rail consisted of a common flat bar, weighing 15lbs to the yard, and fastened on wooden string pieces, by iron spikes. This simple and cheap plan of construction was adopted from the necessity of the case, arising from the very limited resources of the Company. When the Charleston and Hamburg Railroad was undertaken, there was no example of a road of equal extent having been undertaken either in Europe or America, and the project had therefore to encounter a weight of prejudice and opposition against which it had long to struggle.

The perseverance and public spirit of its projectors carried it successfully through, and it stands now a monument of their wisdom and patriotism. As the business of the Road however, began to increase, it soon became apparent, that a road constructed so slightly, of such perishable materials, and with so thin and light a rail, could not possibly answer

* Since making this Report, accounts have been received of Gen. Hamilton having effected the loan of $2,000,000, in London, at an interest of five per cent. and on a credit of twenty-six years. Of this sum half a million of dollars have been ordered to Charleston in *specie*, to enable us to put our Bank in operation under the most favorable circumstances.

the expectations of the public, nor to secure to the Company the vast advantages that might be expected from a more solid structure. Measures were accordingly adopted for the purpose, in effect, of re-constructing the Road, by throwing up an embankment along the whole line, and laying down a new and heavier iron rail. Great progress had been made in this important work, when it was determined that our Company should become the purchasers of the Road. Since that purchase was effected, the work has been pushed with much vigor, and there is every prospect of our having the Road in complete order, in the early part of the ensuing year. When this shall be accomplished, there will be every reason to hope, that the expenses of the Road will be so greatly diminished, and its business so much increased, as to enable us to give to our stockholders a handsome dividend from this source, after providing for the interest of the debt contracted for the purchase and repair of the road. In the measures adopted and prosecuted for the improvement of this Road, the country is largely indebted to the late President, John Ravenel, and his successor T. Tupper, Esq.

Under the administration of these gentlemen, have been devised and executed these important measures, which promise to make the Charleston Railroad, one of the most useful and profitable in the Union. It will be seen from Mr. Tupper's Report, that experiments are now being made under his direction, for the purpose of testing the efficacy of a preparation of corrosive sublimate in giving greater durability to timber used in the construction of railroads. This process, called, "Kyanizing," (being invented by a gentleman of the name of Kyan, in England) has for some time past commanded the attention of scientific men, and the public authorities in Great Britain. Experiments, made under the orders of the Admiralty, have shown, that while one part of a stick of timber, saturated with the solution, has remained for several years, without any appearance even of incipient decay, another portion of the same stick became so completely rotten, as to be entirely unfit for use.

Several ships, as well as public buildings, have accordingly been constructed in England of Kyanized timber, and the problem will soon be solved, as to the benefits to be derived from it. Should the results be favorable, the timber of the South will become a *durable material* for the construction of railroads, an event, which cannot fail to have a most auspicious influence on our fortunes.

We would next call the special attention of the Stockholders to the annexed table taken from the report of Mr. Tupper, which exhibits a gratifying view of the increasing business on the Charleston Railroad, even in its present unfinished state.

Statement of the Income of the South-Carolina Canal and Railroad Company, and of the number of Bales of Cotton conveyed to Charleston upon the Road, from 30th October, 1830, to the 30th June, 1838.

| | No. Pass. | Amount Pass. | Amount Freight. | Mails, Storage, &c | Total Receipts. | No. Bales. |
|---|---|---|---|---|---|---|
| Oct. 30. 1830, to Dec. 31, 1833. | | | | | 44,070 73 | |
| In 1834, | 27,649 | 17,050 35 | 83,214 44 | 4,294 66 | 166,559 54 | 24,567 |
| In 1835, | 32,283 | 109.576 61 | 131,782 94 | 8,394 35 | 249.753 90 | 34,760 |
| In 1836, | 82,216 | 129,982 34 | 140,033 84 | 1,595 01 | 271,613 99 | 28,497 |
| In 1837, | 45,554 | 131,282 61 | 138,269 17 | 10,663 10 | 280.214 88 | 34,395 |
| In 1st half y'r 1838. | 26,808 | 80,642 77 | 78.096 69 | 6,641 91 | 164,231 37 | 17,975 |
| In 1st half y'r 1837. | 22,506 | 71,202 12 | 46,581 26 | 5.200 14 | 122.077 52 | 6,220 |

The able report of Major McNeill, the Chief Engineer, with the accompanying documents, will fully explain the operations of the Engineer department, during the past year, and the report of the Treasurer will exhibit the state of the finances.

It will be seen from the report of the chief Engineer, that we have succeeded in South Carolina in inducing the planters to enter into contracts for the graduation of the Road through their respective plantations—thus bringing into operation the Slave labor of the country for railroad purposes. The very strong objections urged against bringing white laborers from abroad, to mingle with our slaves on the large plantations—the necessary suspension of operations, where white laborers are employed during the sickly season (unless we were prepared to witness a destruction of life shocking to humanity) induced us at an early period to make great efforts to prevail upon the planters to take contracts. In the beginning this was found to be no easy task. By proper explanations, however, and making a small addition, in the first instance, to the estimates of the Engineer, the object was effected. The experiment has been so entirely successful, that when the second division of the road was offered for contract, the competition was so great, as to enable us to make contracts in every instance at or below our own estimates. Indeed, we may now say, that in the Slave holding States, we can command slave labor to any amonnt for the construction of our Railroads, and this too, at reasonable prices. In reference to this subject, Major M'Neill in his report, states.

"The daily useful effect of this labor, has been proved by our own experience, in the work now going on below Columbia—to be full as great, as that of the white laborers, on which elsewhere we mainly rely. Indeed, it has in more than one instance exceeded what has fallen uuder my observation elsewhere. A negro has excavated of light earth, 23 cubic yards in a day, thrown the same into a barrow, and carried it an average distance of 35 feet; and a whole gang has in like manner disposed of 18 cubic yards, while the labor of the white man at the North, on a similar soil, is estimated at 15 cubic yards, an amount which the negro is found to perform easily and cheerfully." We consider this result as very auspicious for our enterprize. While the planters in these portions of the country, where slave labor abounds, will thus find profitable employment for their slaves, they cannot fail to become deeply interested in the success of the work ; their lands will be rested—emigration prevented—the money expended on the Road will be distributed among our own people, and the country every way benefitted and improved. When in the progress of the work, we shall approach those regions where white labor abounds, this will be called into requisition and the farmers and laboring men along the line, will find constant and profitable employment, as well as a ready market for all their productions. Thus will this work, even in its progress, serve to enrich and fertilize the country, through which it will pass—giving a foretaste of the more extended and substantial benefits, that must flow from its completion, and constantly swelling that tide of public opinion, on which we mainly depend for our success.

Referring to the Engineer's Reports for detailed information on all matters connected with the Engineer Department, we shall merely here advert to the very favorable character of the route between Branchville and Columbia, and the gratifying prospect presented, of our being able by a new Gap recently explored by Major M'Kee—near Wheeler's Gap—to find a better passage across the Cumberland mountains, than any heretofore discovered. "By Big Creek Gap, (says Mr. M'Kee,) it appeared very clear to me, that a grade of 60 feet to the mile could be carried over the mountains, without varying materially from its *natural surface*, and *without what is called a development*" If on a further survey, this should prove to be the case, very little doubt can be entertained that a road may be constructed by this route at a grade probably not exceeding 50 feet. On a recent visit to the Baltimore and Susquehanna Rail Road, the President of this Company found the Locomotive Engines ascending with great ease, grades of 60 feet to the mile, and near the summit of the ridge, of 84 feet to the mile*—and he was informed by Major Trimble, the chief Engineer of the work, that one Engine of ordinary weight and construction had carried up to the top of the plane, a weight equal to 250 passengers, at a speed of 7 miles an hour. The Road from Branchville to Columbia, it will be seen is, in almost its whole distance of 66 miles, a series of straight lines, and in the few instances in which deviations have been admitted, the curve are on radii of from 2,800 to 5,700 feet, the line varying from a level, to 25 feet to the mile—and even this inconsiderable rise, is found but for a few miles on the entire route. Of the plan of construction proposed by the Chief Engineer, it is not necessary for us at this time to say more, than to express our entire concurrence in the general views he has presented in favor of a heavier Rail, and a more permanent structure than has usually been resorted to, in the Southern States. The Rail Roads heretofore constructed in this country have varied from a mere frame work of wood, and a flat rail of 15 lbs to the yard, to a solid stone structure, with the T. or H. Rail, weighing 60 lbs. to the yard, and costing from $5,000 to $50,000, the mile. In England, the solidity and expensive character of their works, have in some instances carried up the cost to upwards of $100,000 per mile. Now it is obvious, that if Rail Roads in this country could only be constructed at the enormous expense incurred in England they could not in the present condition of our country, be constructed at all; and we will add, if Rail Roads could only be made amongst us, at the cost of many of those which have been built in the Eastern States,—*we* should in like manner, be deprived of the benefits of such works. As Major M'Neill has well observed, the "British fashion," in these things is wholly inapplicable to this country.—and we will add, that the most expensive structures of the North, are equally inapplicable to the Southern States. There is, however, a wide range for choice between the most expensive Railways of the North, and the frail, and imperfect works that have been erected, in many instances at the South. The skill of the Engineer, and the judgment and experience of the Board, must be exerted in adopting the *proper medium*, having a due regard to economy on the one hand, and durability on the other. We have many advantages in this respect over the States further North—of which we should avail ourselves to the fullest extent. Pine timber admirably adapted to the construction of Railroads, is, in general, to be found in the greatest abundance in the track of our roads. We have a level surface and a sandy soil, and will not find it necessary to guard against the effects of the frost in winter, which makes *an addition of* $5,000 *a mile*, to the cost of Railroads at the North. We have a species of labor which can be commanded to almost any extent without any increase of expense on

* This work, we understand, was planned by Major M'Neill, our Chief Engineer, who resigned his situation as Chief Engineer on that Road, when he entered into the service of our Company. The work has been executed by Isaac Trimble, Esq. his successor.

account of the *increased* demand, and without the smallest liability to riot or civil commotion; and finally, when our roads are completed, and our steam engines are set in motion, we have an inexhaustible supply of fuel costing only a third or fourth as much as is paid at the North. These are advantages that cannot be too highly estimated. In prosecuting our surveys for the ensuing year, it is proposed to cause the Deep Creek Gap, pointed out by major M'Kee, across the Cumberland Mountains, to be carefully surveyed, and the facilities it may afford for the passage of that range ascertained. We shall also be prepared to prosecute such further surveys in Tennessee, North-Carolina, and Kentucky, as the Directors from these States shall deem expedient, and for which the necessary funds may be provided. It is proposed, that the sections of the Road between the Lexington and the Kentucky River, and between Knoxville and the North-Carolina line, shall be more minutely surveyed, with a view to the location of these portions of the Road at the proper time. With respect to that part of the Road extending from Columbia to the Butt Mountain Gap, several routes have already been surveyed, all of which have been found to afford great facilities for the construction of a Railway. A careful comparison of the relative advantages of these several routes, will require a more minute examination, which will be made prior to the final location of the Road, which will take place as soon as our Bank can be put in operation, and sufficient progress shall be made on the work, now going on below Columbia. We shall commence the construction of the work above Columbia, as soon as circumstances may permit, and in the mean time will take all proper measures to inform ourselves fully of the relative advantages of the different routes, so as to be able, finally, to select *that route*, which on a careful examination and impartial comparison with others, shall be found best adapted to our purpose. In concluding this Report, the Board cannot refrain from offering that heartfelt congratulation to the Stockholders, on the success which has thus far attended our efforts. As the noble work in which we are engaged, is the greatest enterprize of modern times, so it has been attended by difficulties almost unexampled. Of these we have already given a brief statement, and shown that they have been so far, happily overcome. The means now at our disposal, properly exerted, cannot fail to ensure success. The loan of $2,000,000 in Europe, the establishment of the Bank, the proper improvement of the Charleston and Hamburg Railroad, and a prompt compliance on the part of the Stockholders, with all such demands as the progress of the work may render necessary, aided by harmonious counsels, and vigorous measures, cannot fail to accomplish our great work. Let us never for one moment forget, that ours is not an enterprize founded exclusively on a calculation of pecuniary advantages to the Stockholders. Though the liberal provisions in our charter prove, that the Legislature have not been unmindful of the interests of the Company, yet there are higher and holier objects connected with this magnificent project. The great object IS TO BREAK DOWN THE MOUNTAIN BARRIERS which separate two entire sections of our common country—to bring the South and West together—and to bind them forever to each other in the bonds of A FREE SOCIAL AND COMMERCIAL INTERCOURSE, the only sure foundation of a PERPETUAL UNION. In the promotion of this grand and noble object, let the Directors and Stockholders pledge themselves to each other and to the world, never to intermit their efforts, until a Railroad communication shall be established between the South Atlantic, and the navigable waters of the West, and while we move steadily forward in this noble work, let us resolve to consider nothing accomplished, while any thing remains to be done.

By order of the Directors,

ROBERT Y. HAYNE, President.

Ashville, N. C. Sept. 17th, 1838.

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*Extract from the Annual Report of the Council of the Institution of Civil Engineers.*

The Council have to regret the loss to the Institution by death of its Member, Arthur Woolf. This distinguished individual was born at Camborne, in Cornwall. He was a millwright, and in that capacity went to London, and was employed in Meux's Brewery. In 1804, he took out a Patent for his Two Cylinder Engine, working high pressure steam in a small cylinder, and allowing it to expand in a large one. When he first commenced erecting engines in Cornwall, he induced the proprietors of the foundries to improve their machinery, that a better style of workmanship might be used in the manufacture of steam-engines; and he introduced an improved Hornblower's double beat valve. The work done at the Consolidated Mines, proves him to have been a person of great talents. In October, 1814, the average duty of the engines in Cornwall was 20½ millions; Woolf's engine at Wheal Abraham, however, performed 34 millions; and in December 1815, 52 millions; and in May, 1816, 57 millions; while the average duty of all the engines reported in Cornwall was 23 millions. In 1820, Mr. Woolf erected engines at the Consolidated Mines having cylinders of 90 inches in diameter, and a stroke of 10 feet —the most powerful that had ever been constructed. In December, 1827, a trial took place with one of Woolf's 90-inch engines, and it performed a duty of 63½ millions—the average duty of 47 engines reported in this year was 32 millions. For some years before his death he received a pension of 100*l.* a year from the proprietors of the Consolidated Mines. His name is associated with the improvements in the drainage of the Cornish Mines; and whatever share posterity may assign to his individual genius in these improvements, his name is recorded in the page of history among those who have dedicated their talents and the opportunities of a long life to the advancement of practical science.

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*Abstract of Papers read at the Institution of Civil Engineers, January 9th,* 1838; W. Cubitt, Esq., V. P., in the Chair.

"On the Duty of Cornish Engines, by Thomas Wickstead."

Mr. Wickstead having obtained permission to make a trial of an engine upon Holmbush mines, near Callington, proceeded to ascertain, with grest accuracy, the dimensions of the engines and the pumps, and the duty performed.

The diameter of the cylinder was 50 inches, and the whole height of the lifts 535 feet 6 inches, and the diameter of the tie and rose lift pumps were 11 inches, and the bottom lift 10 inches.

He had 94lbs. (a Cornish bushel) of coals weighed, and took every precaution to ascertain exactly the work done by this quantity. Previous to the trial, the length of the pump-stroke, viz. 5 feet 1 inch, was measured, and the quantity of water delivered per stroke was found to be equal to 285·6lbs. The steam was cut off at one-sixth of the stroke, and the temperature of the cylinder in the jacket fully kept up by a free communication with the steam in the boiler. In making the trial, the fire under the boiler was worked down as low as could be without stopping the engine—the pressure of the steam being 40lbs. on the square inch in the boiler. Taking the counter, and the time the engine was started, at the end of 2¼ hours the fire was lowering and the speed of the engine reducing, and it was necessary to have more fuel; the 94lbs. of coal having been consumed, the engine was then stopped, and the counter again taken; it had made 672 strokes, or nearly 5 strokes per minute; the weight of the water raised was 1,918,282lbs., so that the product of the weight and the height through which it was raised, expressing the performance of the engine, was 102,721,323lbs. of water raised one foot high with 74lbs. of coal.

This result, however, although it shows the quantity of water raised, does not show the duty of the engine, as no allowance has been made for the unavoidable leakage of the pumps; the fairer method, therefore, of calculating the duty of the engine is from the product of the areas of the pumps, the length of the stroke, and the pressure due to the column of water equal to the height of the lifter; and the duty of the engine in question, calculated upon the above principle, is equal to 117,706,992lbs. lifted one foot high with 94lbs. of coal. The author observes, that the engine had not been overhauled, or anything done to it, to prepare for the trial, the particular engine upon which the trial was to be made not having been determined upon until the previous day; also, that the boiler and flues had not been cleaned for eleven months. The object being to prove what could be done by an engine worked upon the expansive principle. Mr. Wickstead considered that a trial for two hours would prove the capability of the engine, although most probably the average duty of the engine for twelve months would not be so great as it was for the short time that it was under trial.

Having calculated the effect which could have been produced by the steam-power, provided the engine and pump gear had worked without friction, the difference of the result obtained, and the *duty* of the engine, shows the amount due to the friction, which in the present case was equal to 93,751,710lbs. raised one foot high, or about 7·75lbs. pressure per square inch.

It having been observed that the expansive principle would not answer for rotary or double engines, Mr. Wickstead was induced to make some observations upon a double engine working the stamps for breaking the copper ores at the Turcroft mines The steam was cut off in the down stroke at two-fifths, and in the up-stroke at one-third, the engine working with a very equal velocity, and upon an average consumption of coal of 30 bushels for the twenty-four hours. The engine was working a set of stamps—a pump—a crushing machine—and a tumking machine; and the result of the calculation was, that the duty done by the engine was 56,525,072lbs. lifted one foot high, with a bushel, or 93lbs. of coal.

Mr. Wickstead has given two tables; the first is a table, chronologically arranged, exhibiting the gradual improvements of the steam-engine in the course of 66 years; the second, the average duty performed by the engines in Cornwall in 1835 and 1836; and, on the authority of Mr. John Taylor, a comparison of the depths of the Cornish mines at different periods, the water raised and the coals consumed, showing a saving upon the books of the mines proportionate to the improvements in the working of the engines, stated to have been made during those periods.

The average weight of the coal used in Cornwall is 93lbs. per bushel, and that the 94lbs. above mentioned was the Cornish bushel by weight and not by measure. The coals used in Cornwall are nearly all imported from South Wales, and chiefly from the ports of Swansea, Neath, and Llanelly, but are generally of second-rate quality, the better sort being selected for other purposes.

The advantage gained by having steam of a high temperature in the steam jackets of expansive engines is very great. The best engines in Cornwall have the steam jackets supplied from a pipe communicating directly with the boiler. About eight years since, the jacket of an 80 inch steam cylinder at Wheal Towan mine became leaky at the joints, and they were obliged to shut off the steam from the cylinder jacket for a month; that immediately upon so doing they were obliged to pack the piston afresh, as it would not work, which was attributed to the contraction of the cylinder, in consequence of their being less heat, there being no steam in the jacket; that the duty done by the engine this month was but 55 millions, whereas, when the steam was admitted into the jacket, both before and after this period, the duty done was 70 millions.

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"On Captain Huddart's Improvements in Rope Machinery: by W. Cotton, Esq."

Captain Huddart's attention was directed to the subject of rope-making, in consequence of observing every morning during a voyage that some of the external yarns of the cable were broken, even when it had undergone no very heavy strain.

The cause of the failure of the yarns soon became apparent, in that the strands being all of the same length, an additional strain was of necessity thrown on the external yarns by the process of twisting, when the internal yarns were kinched up.

This defect he proposed to obviate, by giving to each yarn an increased length in proportion to its distance from the centre of the strand, and the angle at which it was laid; for this purpose he invented a machine which he termed a register, which so regulated the length of the yarns as to make them, when twisted into a rope, all bear their due proportion of the strain.

The entirely satisfactory results attending Captain Huddart's experiments rendered him anxious to see his plan of rope-making tried on an extensive scale, and ultimately the partnership of Huddart and Co. was formed, and works at Limehouse were commenced and completed under his superintendence.

For many years the machinery was only employed in the construction of the strand, by which the great increase of strength was obtained, the rope being completed by hand in the usual manner by four gangs of men, three gangs giving what is termed the hard to the strands and keeping up the twist, as the other gang twisted them the other way into a rope; the correctness of this operation depending on all these gangs working with proportionate power and activity, it was frequently found that the strands were not laid in the rope with such accuracy as to allow each of them to bear its proper proportion of strain; and in order to render his plan of rope-making more complete, he designed the large laying machine, which effectually prevented the defects which it was difficult to avoid under the old system.

January 30, 1838. The President in the Chair.

"On the relative advantages and disadvantages of Four and Six Wheels for Locomotives; by Edmund Woods."

The engines at first introduced upon the Liverpool and Manchester Railway were found to be much too slightly constructed for sustaining the shocks and the strains to which their high velocities and the inequalities of the road continually exposed them; so that, after a short period, each individual engine required and underwent a thorough and general repair. These repairs consisted in the substitution of greater strengths and more approved forms of material, together with a mode of connexion of the parts better adapted to resist the repeated and periodical concussions. Thus the outer and inner framings were stayed—wooden wheels replaced with iron ones—crank axles constructed with nearly double the original quantity of materials—pistons, piston-rods, connecting rods, and brasses, were proportionably enlarged, until little remains of the old engine but its boilers and cylinders. The weight of the engine was increased, in consequence of these alterations, from about four and a half tons to nearly ten tons. The effect of this increased weight upon the road could not be otherwise than highly prejudicial, and the result was, that the road originally formed of rails intended to support a moving mass, not exceeding four and a half tons, distributed upon four wheels, was constantly out of repair, the rails being seriously bent, becoming loose, and frequently broken; so that it was found absolutely necessary to relay the whole line with stronger rails, and, as a temporary expedient, to substitute props under the rails between the points of support, and to add a third pair of wheels to the back part of the framing of the engine, behind the fire-box. The advantages obtained from the alterations, and the additional pair of wheels, were almost immediately apparent. The engine lost in a great degree its peculiar rocking motion, as also the unsteadiness arising from lateral undulations. Besides such direct and immediate results, time soon developed further consequences of an important nature, the component parts of the engine remaining for a much longer period securely united and firm, the fastenings of the tubes ceased to leak and give way, and the framings retained more permanently their fixtures, besides the increased safety in the diminished liability of the engine to run off the rails in the event of any accident. The author then considers the often-agitated question of an outside framing to the engines, and proceeds to the consideration of the principal objections against the use of six-wheeled engines, which objections are—1st, The less adhesion to the rails than four-wheeled engines; 2dly, That the axle and weight of the wheels adds to the resistance, and consequently detracts from the available power; and 3dly, That they cannot traverse curves without increased strain and friction. With regard to the first, it is true that the adhesion is less, adhesion being proportioned to the pressure; but the real question to be considered is, whether the ratio between the adhesion and the power of the engine is not sufficient for all practical purposes; and from the working of the Liverpool and Manchester line, it appears that such is the case. To the second objection, Mr. Woods does not attach much importance, as the additional weight of a pair of wheels, axle, springs, &c., does not exceed 12 cwt., and, therefore, on a liberal estimate, cannot diminish the tractive power of the engine by 1-200th of the whole.

With respect to the third objection, the tendency to strain and friction in passing round curves, and the difficulty of taking the points, is entirely obviated by a very simple expedient. The plummer blocks of the hind wheels are made very light and elastic, so that they will yield readily sideways to an impression For this purpose, it is found better to use small wheels, say three feet in diameter, that the plates may be long, and the axles at a considerable distance from the framing. Such methods render six-wheeled engines capable of travelling safely curves of eight chains radius, at a speed of six to eight miles per hour; and an instance has occurred of a small curve of even four chains radius being passed at a slow speed.

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"On Improvements in Water Wheels; by Isaac Dodds."

The result of many experiments, with a view of lessening the bad effects produced by the back water upon the water-wheels on any sudden rise or flooding of the stream, had led Mr. Dodds to recommend the adoption of two air-vessels, which may press the sides or water guides, and serve to carry the wheel; those, when properly ballasted, may raise or lower the wheel and the machinery, according as the water is higher or lower, the race being so adapted that the dam-head may be raised in the same proportion as the back-water.

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February 13.

"A Description of the French Method of Constructing Flat Roofs with Earthenware Pots; by F. W. Simms.

Mr. Simms having a short time since visited Paris, with a view to examine into the nature and various applications of the asphaltic mastic of Seysel, there extensively employed in the construction of foot-pavements, the covering of roofs, and other purposes, was led, in the course of his inquiries, to examine the construction of the roof of the Manutention des Vivres de la Guerre, Quai de Billy, which is formed of earthenware pots and coated with asphaltic mastic. The roof, which forms a terrace, is nearly flat, having just sufficient inclination to carry off the rain; the voussoirs of the flat arches are formed of the cylindrical earthenware pots,* nearly resembling our chimney-pots, with the exception that both ends are closed, and one end being finished off nearly square. The dimensions of the pots vary with the size of the roof to be constructed; those used in the abovenamed roof are about nine inches long, and five inches in diameter. The thrust of the arches is resisted by iron bands, and the external walls firmly tied together, and between them and the longitudinal middle wall the arches of the roof are turned with these pots set in mortar. The soffit of the arches being covered with plaster, forms without the intervention of timber, the ceilings of the upper apartments. The extrados of the arches is covered with beton, which is spread so as to give the required inclination for carrying off the water; this surface is afterwards carefully smoothed over with a thin coating of hydraulic mortar, which when dry is itself covered with canvass stretched tight; upon the canvass is poured the asphaltic mastic in a semifluid state, which setting in a few minutes, forms the finished surface of the terraced roof. Mr. Simms details some facts showing the surprising strength of the roofs thus constructed, and their easy reparation when injured.

* This method of forming arches has been adopted in England for many years; several roofs at the Bank are thus constructed.

February 20.

"Dercription of Clegg's Dry Gas-Meter."

The meter invented by Mr. Clegg for measuring gas may be applied to other useful purposes, as the registering the average pressure of high-pressure steam every hour, day, or all the year—the average temperature of heated air, as it leaves the boilers of steam-engines---or registering any variable temperature for any period.

The principle of action of the dry gas-meter is the evaporation of spirits of wine, which is well known to vary *directly* as the heat.

To contain the spirits of wine, and to cause a perpetual action as long as the heat is applied, there are two glass globes, about 1 and ¾ inches diameter, ½ an inch apart, joined together by a glass tube of about ¼ inch bore; these globes are balanced upon an axis, about which they can freely revolve; one globe is nearly filled with spirits of wine, and in the other a perfect vacuum; these globes are suspended in a frame upon an axis, the gas from the main is then introduced by means of a pipe conducting it to the underside of a gas-burner placed over the globes, which is always lighted when the meter is in action, the gas in its passage is thereby heated, and then conducted by a continuation of the same pipe, terminating by two orifices of nearly equal area, the lower one being rather the largest. These orifices are opposite the centre of each globe; it is obvious, therefore, that the excess of heat would be on the lower globe, and, as the temperature of the burner above the meter varies, so would the excess of heat on the lower globe, and in this state would be useless, as the correctness of the meter depends upon an uniform temperature between the globes, whatever be the temperature of the source from whence it is derived. This uniformity of temperature is accomplished by another portion of gas, much colder than that portion which comes in contact with the burner, but still heated from the same source, blowing upon the upper bulb, this orifice exceeding the difference of area of the two orifices before mentioned, as the temperature of the gas in the lower orifice exceeds the temperature of the colder portion of the gas which is discharged upon the upper globe, so that, if the gas discharged upon the lower globe receives more heat from the burner, the portion of colder gas receives the same quantity of caloric, and counteracts the effect which would otherwise be produced.

It is then ascertained by actual measure what quantity of heated gas will cause the spirits from the lower globe to be driven into the upper one, and this once ascertained, is as much to be depended upon as the vibration of a pendulum.

The globes are so adjusted upon their axis that they remain at rest when one globe is over the other, but so far out of the centre of gravity, that when the spirits from the lower globe is discharged into the upper one, it will by its weight descend, thus causing a vibrating motion, these vibrations being registered by a train of wheel-work as in the water-meters.

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"On the Application of Steam."

The minutes of the discussion on Mr. Wicksteed's paper and the Cornish engines having been read, Mr. Parkes called the attention of the Institution to the importance of the question of the applicability or inapplicability of the Cornish system of using steam to condensing engines generally. It seemed to him, after the confirmation of the statements regarding the Cornish engines had lately received from the praiseworthy exertions of Mr. Wicksteed, that, as regards economy of fuel, the Cornish engine was even still more superior to the low-pressure engine, than the latter was (at the period of its invention by Mr. Watt) to the original atmospheric one; that there existed, indeed (if all we heard were true), less economical difference between Mr. Watt's and the high-pressure or non-condensing engine, than between the Cornish and the common Boulton and Watt engine. If such were the case, which could now scarcely admit of a doubt, Mr. Parkes thought, that the interests of science and the arts demanded a much more thorough and searching investigation into the rationale of the Cornish engine than had yet been made; and he thought it a reproach to the Institution, that no one of its members is yet prepared to say, whence arises the superiority of the Cornish engine, nor what is the relative value of the various perfections which had been for so many years assigned to it by its employers.

Mr. Parkes thought that most engineers were agreed, that the low-pressure crank-engine, used for manufacturing purposes, required, in its highest state of condition, at least ten pounds of good coal per horse per hour; that such was Mr. Watt's own estimate, allowing one pound of coal for the evaporation of seven pounds of water. He had had many opportunities of proving—so far as the Indicator can be relied upon—the load and consumption of Boulton and Watt's own engines, as well as engines by other makers; but only in three instances had he found the consumption so small as ten pounds. He had only in one instance been concerned in ascertaining the duty done by a pumping engine---which was one of the same kind---not working expansively; and as this experiment was conducted with the most rigorous exactitude, the correctness of the results might be relied upon. The engine was nominally one of forty horses' power, constructed by Messrs. Hick and Rothwell, of Bolton, erected at St. Ouen, near Paris, and employed to raise water, by means of a scope-wheel, to supply a new dock. The experiments of two consecutive days were managed and checked by M. Arago, M. Jouy, Mr. H. Farey, and Mr. Parkes. By the Indicator the engine proved to be working exactly to forty horses' power, with a consumption of eleven pounds of good Mons coal per horse per hour; but as the actual weight of water raised, one foot high per minute, divided by forty horses, attained 36,000 pounds, the real consumption was about ten pounds of coal per horse per hour. Mr. Parkes adduced this experiment, with an engine of the most perfect construction and in perfect condition, as evidence, that the duty of the common low-pressure crank-engine, not working expansively, does not exceed twenty or twenty-one millions of pounds raised one foot high by ninety or ninety-four pounds of coal; and thus that the Cornish engine, investigated by Mr. Wicksteed, exceeds such engine, in economy of fuel, in the ratio of five to one.

Mr. Parkes then entered at some length into a consideration of the various phenomena to be observed, and facts to be ascertained, in order to determine the separate value of the parts of the system adopted in Cornwall. The assertion that the boiler was superior to others, would be confirmed or disproved by measuring the water evaporated by the fuel used---which might also be done with such accuracy, as to furnish us with the very important knowledge of the quantity of water in the shape of steam required for each stroke of the piston. A thermometric steam gauge should be fixed on the boiler, and another as near as possible to the cylinder, to determine both the pressure within the boiler, and at what pressure the steam really enters the cylinder. He suggested also that another such thermometer, fixed on the cylinder cover, might be useful, in conjunction with the Indicator, to determine the increments of expansion, as well as the highest and lowest degree of pressure within the cylinder. That it appeared to him that the Cornish engineers had carried out to perfection Mr. Watt's axiom, that "the cylinder should be maintained as hot, and the condenser as cold, as possible," and that since the hot jacket probably played a still more important part to the cylinder of an expansive than to a non-expansive engine, no means should be left untried to ascertain the value of that element. That the thermometric steam gauge might also be an useful adjunct to the barometer, in determining the amount of vacuum in the condenser, and other phenomena connected therewith. The proportions of the air-pump and condenser to the cylinder, adopted by the Cornish engineer, should also be noted, as well as the temperature of the injected and ejected water.

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"On the expansive Action of Steam in Cornish Engines. By W. J. Henwood."

At the commencement of this paper, the author describes, with great detail, the action of the Indicator, and the nature of the evidence which it furnishes on the working of an engine. The author then states the results arrived at on applying this Indicator to the cylinders of some of the best engines in Cornwall. The peculiar circumstances of each case, as the clothing of the boilers, steam pipes, and the various methods adopted for keeping up the temperature of the cylinder, are detailed. The steam cases or jackets of some of the engines were filled with dense steam from the boilers of others with heated air. The dimensions of the working parts and the loads of the engines; the water and steam in the boilers; the temperatures of the hot well of the condensing water, of the boiler shed, engine-house, and external air; the duration of the experiments; the coals consumed, according to weight and measure; the quantity of oil and grease; the number of strokes; the duration of each experiment; and the pressures of the boiler and cylinder, are tabulated for the respective engines.

The greatest duty recorded as performed respectively by the measured bushel, by 84 pounds damp, and by 84 pounds dry, is 86½, 72½, and 77½ millions.

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"Particulars of the Construction of the Floating Bridge, lately established across the Hamoaze, between Torpoint, in the County of Cornwall, and Devonport, in Devonshire; by Jas. M. Rendel, Member.

The width of the river Hamoaze, at the site of the bridge, is, at high-water, 2,550 feet, and low-water, 2,110 feet The greatest depth at high-water is 96 feet, and low-water, 18 feet. The strength of the current at ordinary spring-tides, is from 260 feet per minute, or nearly three knots an hour, to 330 feet per minute, or three knots three-fourths an hour, varying in different parts of the passage; but heavy land-floods, accompanied by a north-west wind, make the ebb-tides run with a velocity of nearly five knots an hour.

The site lies directly at right angles to the line of current, a disadvantage that could not be avoided, as the mooring of the ships of war prevented the selection of an oblique line of direction, and the situation is so exposed, that ships lying in ordinary, in the immediate vicinity of the bridge, sometimes drag their moorings.

The bridge is a large flat-bottomed vessel, of width nearly equal to its length, divided in the direction of its length into three divisions, the middle one being appropriated to the machinery, and each of the side ones to carriages and traffic of all kinds. These side divisions or decks are raised from two feet to two feet six inches above the line of floatation; and by means of strong and commodious drawbridges or flat forms hung at each end of each deck, carriages drive on and off the deck from the landing places without much difficulty, or occasion for the least disturbance of horses or passengers.

The bridge is guided by two chains, which, passing through it over two cast-iron wheels, are laid across the river, and fastened to the opposite stones. Two small steam-engines are employed as the moving power, by turning a shaft, on each end of which there is a large cast-iron wheel, whereon the guide chains rest. The landing places on each shore are simple inclined planes, from low-water mark to two feet above high-water mark, formed to a slope or inclination of one inch twelve or one inch fourteen; and as the bridge approaches, the drawbridge is lowered on the plane.

To prevent the chains being so tight as to interrupt the free navigation of the estuary, or to endanger their breaking, instead of being fastened or moored to the shores, their ends have heavy weights attached to them, in shafts twenty feet deep and sixteen feet square at the head of each landing-place, the weights being cast-iron boxes loaded with five tons each, attached to the ends of the chains, which enter the shafts over cast-iron sheaves of two feet diameter. These weights rise and fall as the strain upon the chain becomes more or less, and prevents the tension ever exceeding the balance weights, which are considerably below the weight to which the chains have been proved.

The length of the bridge, exclusive of the drawbridges, is sixty-five feet; the width at midships, forty-five feet; and at the ends, thirty-eight feet six inches. The draught of water, when the bridge is full of heavy carriages, is rather under two-feet six inches, the clear depth of hold being four feet three inches.

The seat of the bridge in the water, or rather the lines of floatation, are elliptic, and the sides are curved vertically, the object of these forms being to relieve the bridge as much as possible from the effect of the current, and to prevent the sudden stoppage of a wave, and the consequent spray over the side.

The roadways or decks have cross battens to prevent the horses' feet from sliding, and also for the better holding of a thin coat of sand and tar, as a more agreeable footing than wood. The fencing of the sides of the roadway is complete, by carrying the timbers three feet six inches to four feet above the decks, and above that by the chains which suspend the drawbridges forming a rail.

The drawbridges are of the same width as the roadways, and are suspended by two three-quarter inch chains; one of which as before stated, forms a guard-rail to the side of the bridge; the other passes through the engine-house, being there connected with a small purchase machine.

There are two steam-engines, each having a cylinder of nineteen inches diameter, and two feet six inches stroke. They are common condensing beam engines, working at a pressure of three and a half pounds per inch in the boiler, and at an average speed of thirty-five strokes per minute, and but one boiler. The feeding water is procured from a tank on the eastern landing place, and the waste steam being thrown into this tank, is sufficient to raise the water to 100°.

The guide chains are the common cable pattern, each one inch iron, and each link made to a gauge, so as to fit the chain wheels without slipping. When the bridge is on either side of the river, and the chains lie on its bed, and when the bridge is in the act of crossing, they necessarily form two arcs. The weights in the shafts rise and fall from five to eight feet, according as the weather and the tide may happen.

The time of the bridge crossing is seven minutes at low-water, and eight minutes at high-water.

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From the London Civil Engineer and Architect's Journal.

*Cast Iron Bearers.—Extracts from a Paper on the Relative Strength of several Cast Iron Bearers, when subjected to a Transverse Strain. By* Charles Parker, Esq., *Fellow, read before the Royal Institution of British Architects, Jan.* 15, 1837.

The object of the paper was to give the results of a series of thirty-four experiments made by Mr. Parker, in an attempt to compare with one another the relative strengths of several forms of cast-iron beams when subjected to a transverse strain; also, to ascertain the difference in the strength of their sections when close, and when open or pierced, and to give some memoranda of girders that have been executed.

The following comprise the description of beams experimented on by Mr. Parker to obtain the requisite data:

Complete and open rectangular section—Complete rectangular section with webs in the middle—Complete and open rectangular section with web on upper edge—Complete and open rectangular section with web on lower edge—Complete and open rectangular section with web on both edges Complete and open rectangular section with spaces between the webs filled in solid.

The experiments were made on models of sufficiently large scale to allow of that precision in adjustment which is essential to obtain an accurate result. The length of each model when cast was two feet five inches and a half, and the depth was one inch and a quarter.

The principles on which the proportions of the sections were formed was to make the width of the complete rectangular beam the basis of every transverse section; consequently this same width is preserved throughout the whole of the several models in the narrow parts of the section, the webs being added in the proper places to make the required diversity of form. The depth and the length of the beam between the bearings in each of the examples were the same. The beams were supported horizontally at both ends, and strained by a force acting perpendicular at the middle point between the props. The quantity of deflection was multiplied by means of a lever index, and the pressure was continued three minutes before any addition was made to the weight. Four experiments were generally repeated of each section, and the strain was increased by fourteen pounds at a time, till the beam was fractured. The proportion of the iron used in the castings, were equal portions of hot blast calder iron and plate iron, taken from a cold blast cupola.

The following are the results of the experiments on the complete transverse sections:—*

| | | Wt. of Beam. | Breaking Wt. |
|---|---|---|---|
| | | Ounces. | Pounds. |
| Complete Rectangular ............ | A | 28 | 375 |
| Ditto with web in the middle..... | B | 34 | 325 |
| Ditto ditto on upper edge.... | C | 34 | 325 |
| Ditto ditto on lower edge..... | D | 34 | 550 |
| Ditto ditto on both sides...... | E | 42 | 750 |
| Ditto with space between webs on both edges filled in solid............ | F | 90 | 950 |

It is not intended to illustrate the principle of comparison by any numerical operations, or to form constant multipliers applicable to the strength of each separate section. This remains to be done by future experimentalists, as it is considered that the results which have been obtained are insufficient for that object.

From a cursory inspection of the tables, the following deductions are obvious:—That the strength of a beam to resist a given pressure is not in proportion to the quantity of materials it contains; and, that the power of each section to resist the straining force is obtained more by the proper disposition of the component parts than by the contents of the sectional area.

On comparing the several results, it will be perceived that the strongest form is obtained by the relation that subsists among the parts that make the section E, in which the neutral plane is disregarded, and the surfaces of extension and compression are proportionably increased.

Also in the sections B, C, and D, in which the three planes of the area of a beam are severally enlarged, it appears that the increase of material can be applied with advantage only in the lower surfaces subjected to extension; for, when added in the neutral plane, or on the upper and compressed surfaces, it essentially weakens the beam, and renders its powers of resistance inferior to the plain rectangular section A.

The truth of this conclusion is equally deducible from the proportional increase of the deflections with the earlier weights, in those sections where the lower surfaces are not enlarged. It was perceptible also by the shape and appearance of the parts presented where fractured. The whole of the results thus obtained seemed to indicate, that the resistance of the particles to extension is not the same, or equal to the resistance to compression; and on this principle it is suggested that the strongest and most economical section would be obtained by making the upper about half the projection of the lower web.

* By dividing the breaking weight in pounds by the weight of the beam in pounds, we obtain the following data as the proportional strength of each beam:—

| | | Wt. of Beam in Pounds. | Breaking Wt. in Pounds. | Proportional Strength |
|---|---|---|---|---|
| Complete Rectangular . . | A | 1·750 | 375 | 214 |
| Ditto with webs in the middle | B | 2 125 | 325 | 153 |
| Ditto ditto on the upper edge | C | 2 125 | 325 | 153 |
| Ditto ditto on the lower edge | D | 2·125 | 550 | 279 |
| Ditto ditto on both edges | E | 2·688 | 750 | 289 |
| Ditto with space between the top and bottom webs on both sides filled in solid | F | 5·625 | 950 | 172 |

—Editor.

It is also observable, that the sections A, and F, although both rectangular sections, and the latter in the model made three times the breadth of the former, do not preserve the same relative powers of resistance, the section F, with $3\frac{1}{4}$ times the material supporting only $2\frac{1}{2}$ times the pressure ; this result makes caution requisite in the use of the tables of the strength of beams that usually accompany works on this subject, wherein it is argued, that as a beam of an inch in breadth will bear a certain weight, so a piece five times in breadth will be five times as much, and the same as any other breadth, forgetting that in a beam of a certain quantity of material, the maximum of strength is obtained by a certain ratio of the depth to the breadth.

The whole of the preceding experiments were made with the middle portion of the section entire ; but with a view of ascertaining whether the strength of the material would be essentially impaired by removing that portion of it which lies immediately contiguous to the neutral plane, or between the compressed and extended surfaces, several castings were experimented on. Still, before detailing these results, it appears desirable to give the particulars of two experiments that were made on hollow girders of an elliptical section.

1st Experiment.—Two girders 21 feet 2 inches long each; weight of No. 1, 13 cwt. 1 qr. ; ditto of No. 2, 14 cwt. 14 lbs. ; distance between the supports, 19 feet 8 inches ; space between the two girders, 3 feet ; loaded with pig-iron and equally distributed over the whole length ; both castings being defective, they broke with the weight of fourteen and a half tons. The deflection in the centre was three-quarters of an inch under the pressure of ten tons. The fracture in both was two feet from the centre.

2d Experiment.—Two girders from the same pattern as above, being sound good castings; the same distance between the supports, and the same space between the girders; the load equally distributed as in the 1st experiment. Weight of 2 girders, 1 ton 8 cwt. 2 qrs. ; ditto of each girder, 14 cwt. 1 qr. ; both broke under the weight of twenty-one tons exactly in the centre of each girder. The deflection in the centre of the last two, during the process of weighing, was 5 tons $\frac{1}{2}$ an inch, 10 tons 1 inch, 15 tons $1\frac{3}{8}$ of an inch, 20 tons $1\frac{5}{8}$ of an inch.

It is scarcely necessary to mention, that the principle of strength in this section is taken from nature, where it is beautifully exemplified in the bones of many animals, in the structure of birds, and in the stems of most plants; but the advantages the form offers are defeated by the difficulty of obtaining sound castings, where the length exceeds the distance given in the experiments, namely, twenty feet.

Mr. Parker states, that, by taking away the parts about the axis, or hollowing the mass, slightly impairs its power to resist a transverse strain, while it produces a form of section that combines the least quantity of material with the greatest strength.

These two experiments therefore show, that, in the direction of the length, a portion of the neutral plane may be cut away without much injury to the strength of the beam, but as there is often a portion of the neutral plane removed in the direction of the breadth, the result of the experiments before adverted to remain to be mentioned.

Mr. Parker then proceeds to make some remarks on *open or pierced beams.* It has been generally considered, that in pierced beams, the disposition of the middle surfaces of the depth may be regulated by fancy; and that, provided sufficient diagonal and cross-ties are allowed to connect the upper and lower portions, and prevent irregular contraction in the metal, no strength can arise from the distribution of these parts. Leaving this question for future inquiry, it is necessary to mention, that the plan of opening the beams, which was followed throughout the whole of the models, was similar to that recommended by Tredgold. Thus, the rectangular section had five-eighths of the entire depth taken away, and the several remaining portions disposed so as to keep an equal bulk in every part. The apertures had both ends circular, and both sides parallel, with the outer edges, thus connecting and giving stability to the whole beam.

The object now sought, was whether beams, having a portion of the middle cast open, were as strong and stiff as when cast solid, and after many trials the following were the conclusions.*

That beams of equal depth and breadth when cast solid are stronger and stiffer than when cast open.

The equal weights produce equal proportional deflections in the same section, whether cast open or solid.

That the strength and stiffness of the solid to the open section is in exact proportion to the quantity of material used in each section, and which, in the present case, may be numerically expressed as one third in favor of the solid.

Such are the results of the experimental researches made on this part of the subject, for which, from our prior view, we were little prepared. How far these effects might be modified by a different manner of opening the neutral plane, is matter of conjecture, and can only be determined by experiment. Indeed, from the constant assertions that had been previously made, we were imbued with the idea, that when a certain quantity of metal is cast into the form of a beam of a given depth, it was both stronger and stiffer if *pierced* than it would be if left *solid*. The results have proved this to be erroneous; and should it now be advanced on the ground that the equal quantity of metal, and not the equal depth of the two sections, are to be regarded, still, if found correct, it will not alter the general consequence that may be inferred from the experiments, namely, that into whatever forms the middle portion of the beams may be moulded, the advantage will be comparative, and there will be no deviation from the principle that has been found to operate in the hollow girders.

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*Opening of the Newcastle and Carlisle Railway.*—On Monday the opening of this railway took place with considerable ceremony and festivity. The distance of the line from Newcastle to the Castle Basin, at Carlisle, is 61 miles. "The anniversary of the battle of Waterloo, which crowned the British arms with success, and restored peace to Europe," says the Tyne Mercury, "was selected as the day on which to celebrate the event, and one of the engines is named the Wellington. Different portions of the railway have been opened from time to time, and made available to the commerce of the North; but on Monday the whole line was passed over for the first time. The engines started in the following order: First, the Rapid, as an advanced guard, and without any train, displaying the union jack, which has long 'braved the battle and

* We regret that Mr. Parker did not give the particulars of these experiments, as they are most important.—Edit.

the breeze;' next, the Meteor, with four carriages and a flag, on which was inscribed, 'England expects every man to do his duty.' In this train we observed the Mayor of Newcastle and his friends, and the Allenheads band; then followed the Victoria with nine carriages, the Wellington with nine, the Nelson with seven, the Lightning with ten and the Carlisle band; next, the Tyne with its steam organ and nine carriages; after these came the Carlisle with eight, the Eden with ten, the Goliah with nineteen and about 600 passengers; then the Atlas with seventeen, next the Sampson with eleven; in this train there were very few passengers, but it was succeeded by the Newcastle with nine carriages well filled, and a flag hoisted, 'Prosperity to Newcastle,' followed by the Hercules, the last of the list, with eight carriages. The aggregate number of passengers in all the trains, upon a fair computation, exceeded 3,500, and the procession, previous to starting, reached nearly half a mile, but when in motion, could not be less than one mile and a half, allowing as much space between each train as was consistent with safety.—*London Paper.*

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*Railroad between Charleston and Georgetown.*—We brought recently to the notice of the public a scheme for the connection of Charleston with Georgetown (S. C.) by a Railroad, as part of the line of communication, through Wilmington (N. C.) between the North and South. On conversing with a number of individuals of property and influence, in the district of country through which such a road would pass, and who fully appreciate the benefits of this project, we are satisfied that the cost, including bridges over both the Santees, would not exceed our estimate of $500,000. That an investment by capitalists in such an undertaking would produce as large a return as on almost any railroad in the Union, we feel satisfied, from the great amount of travel that must take place on it. A number of individuals of large means are ready to subscribe to such an enterprise, if an impulse were only given to it. The increasing abundance of money, and the difficulty that must shortly take place of finding advantageous employment for it, render this the acceptable period for the commencement of the undertaking. We should be prepared now to engage in the work, so as to mature it as nearly as possible after the completion of the Wilmington and Raleigh Railroad. We understand that this road will be ready for travellers, on its whole extent, by the 1st of June next, and that the proprietors expect to complete, by the 1st of December next, 110 miles, when it is understood that the great mail between the North and the South will be transported on it.

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*Important to Railroad Corporations.*—In an action brought against the Baltimore Railroad Corporation for the loss of a cow killed by the cars, in the Baltimore County Court, the Magistrate in summing up, took occasion to say, that no proof of negligence had appeared upon the part of the engineer; that on the contrary, from the circumstances, it was evide t that the engineer, in behalf of his own life and the safety of the train committed to his charge had every inducement to prevent such an accident as had occurred; that unless negligence could be shown, no recovery could be had in a case of the kind. The judgment of the magistrate was therefore in favor of the defendants.

AMERICAN

# RAILROAD JOURNAL,

AND

# MECHANICS' MAGAZINE.

No. 10, Vol. I.<br>New Series.] NOVEMBER 15, 1838. [Whole No. 322.<br>Vol. VII.

THE arrival in our country of the Chevalier Francis Anton Von Gerstner, a distinguished continental Civil Engineer, will afford our professional friends an opportunity of receiving from him much valuable information, and of extending to him those courtesies with which they so uniformly receive their Trans-Atlantic brethren.

The Chevalier Von Gerstner is well known as the author of one of the earliest treatises upon Railroads, published originally in German; and since, for his construction of the first Russian Railroad, and others in Germany. His object in visiting our country is to obtain information as to the construction and management of our Railroads.

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DURING a temporary indisposition, an article containing a description of the Philadelphia and Reading Railroad, and which we intended to incorporate with other matter, found its way accidentally to the printer, and thence into our columns, without any notice or credit. We owe an apology to the writer, Mr. G. A. Nicholls, Resident Engineer of the Road, for this unintentional omission. It contains much valuable information in a condensed form, and is well worth the attention of our readers.

We shall feel obliged to Mr. N. for any other communications which he may make relative to this Road.

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*Eight-wheel Cars.*

MUCH as this description of Railroad Car is in repute in the Southern, and a portion of the Middle States—yet in this State, and East of us, there is a singular prejudice in favor of the four-wheel cars, and against the new form.

This same prejudice operated against their introduction upon some of the Southern Roads, but experience has led to the entire abandonment of the old form.

In the first place, the accommodation for an equal number of passengers costs less in long cars than in the short ones. We will suppose the case of an eight-wheel car just double the length of a four-wheel car: there will then be the same length of side in either case, but the two short cars have the additional cost of two more ends, and their entire fixtures.

The arrangement, however, is generally such, that the length of the eight-wheel cars is more than double those of the short ones; there will then be fewer wheels in a train, and moreover the same number of passengers will be carried in a train of less length.

This question of cost has been settled by the investigations of the Baltimore and Ohio, and other Railroad Companies. They had been induced to believe there was economy in the use of short cars, and sent competent engineers to collect information on this subject. The result was, that the price of the eight-wheel cars was found to be much less than for the same accommodations in the short cars. This is reasonable enough, and the only wonder is that the fact should have been doubted.

There are, however, still more important considerations to be taken into account. In the four-wheel cars, the support furnished by the wheels is very near to the centre of the length, and the overhanging weight at each end acts upon a considerable purchase, to strain the centre of the car, and twist it on the trunk. The consequence is, that the rails are pushed apart by the swinging motion thus produced, the wheels are worn, and the whole machinery racked. The narrowness of our Railroad tracks adds to the amount of the mischief—and the longer the cars are, the worse the effect.

In the eight-wheel cars, the weight is contained more between the points of support than on each side, and the consequences are directly the reverse. The motion is easier to the passengers, the cars and the road suffer less. Besides, there is more spring in the long cars when thus supported, and the difference is again in favor of them.

As to the comparative safety, there appears to be no doubt: a car having four wheels near to the centre, when one is broken cannot well be supported on the three remaining ones, particularly when heavily or unevenly loaded. An eight-wheel car, on the contrary, may lose one, or even two, and yet remain upon the track. And in general, when there is any obstruction, they are not so easily thrown off the track as the four-wheel cars—of this fact we have had repeated illustrations.

Again, in turning curves, the long cars are preferable to the short ones, producing less lateral friction, and therefore accommodating themselves to the curves with much greater facility. We have seen a train of three 40 to 50 feet cars drawn through a curve of double curvature, of about their own length, and of short radii, with perfect ease, by three horses, when the same number of passengers in short cars could not have been started. This great advantage is so little understood, that the commonest objection to the long cars is the difficulty of handling them at the depots.

We most sincerely hope that these, and many other circumstances in favor of this form of car, may be duly considered before the selection of cars by companies about commencing operations.

We have examined, with much satisfaction, the various models of long cars, as produced by different makers, and shall some other time refer to them.

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We are much indebted to Col. Aycrigg, for his minute account of the Kilsby Tunnel. We really hope that his example may tempt others to go and do likewise. There are many professional gentlemen who have much valuable information of this kind on hand, and we shall take the liberty of "calling them out," before long, if we do not soon hear from them.

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*Description of the Mode of Constructing the* KILSBY TUNNEL, *on the London and Birmingham Railroad; communicated by* LT. COL. B. AYCRIGG, *one of the Chief Engineers of the State Works of Pennsylvania.*

Farrandsville, Lycoming County, Pa., Nov. 2, 1838.

To the Editors of the Railroad Journal and Mechanics' Magazine.

GENTLEMEN—The following extract from a statement of the expense and manner of tunnelling, just drawn up at the request of an Engineer having charge of a similar work to be constructed, will, doubtless, in some points at least, be interesting to most of your professional readers, and requiring on my part no other labor than that of copying, since the information previously existing in the memory (excepting the numbers) has been committed to writing, I send it to you for insertion in your Journal, should you think proper to add this to the common stock, and thereby induce others to go and do likewise.

The description of the mode of working the Kilsby Tunnel is from my own observation, having through the kindness of Robert Stevenson, the Chief Engineer of the London and Birmingham Railroad, had every avenue to information thrown open to me, and in this case having descended several shafts to see the work in all its stages, from the commencement at the shaft to its completion in joining two finished pieces—a very interesting examination professionally, but in other respects a dirty, wet, and disagreeable tour. Descending 140 feet in skeps covered with dirt or brick dust, climbing ladders, crawling among timbers and through holes, sometimes on hands and knees, and sometimes *snaking* yourself along, as our backwoodsmen say, without the use of your legs, among the mud and wet, occasionally striking your head against the beams—while all your attention is devoted to getting a good foot-hold, in the uncertain light of a small taper. A miner on one side gruffly says, he'll "drink your health"—some one on the other informs you, that it is very cold and wet work—while, for fear that you may overlook something important, two or three of the foremen or inspectors, when they find you come there "by authority," fasten themselves to you like so many leeches. I was favored with no less than three, who accompanied me into half a dozen shafts, and understood perfectly the division of labor, each in his turn explaining something that had perhaps been explained before—until at last you leave the work, wet, dirty, hungry, with your head full of information and your pockets light of loose change, in spite of the regulations of the company against spunging.

To enable you to descend into this nether world, the skep is raised out of the shaft, and a trap door, running on rails, on each side, is shoved over the mouth of the shaft. You step into the basket, and hold on to the rope, the trap door is removed from under you, and you *hang*, like a felon, over a pit 140 feet deep, and would fare as badly as a felon should you lose your hold. But the depth and danger become insignificant, when compared with others that you must experience, if you would see every thing connected with underground engineering. As in my own case, myself and the engineer or coal viewer, as they are called, came within a minute of being crushed under the falling roof of one of the abandoned drifts in the Monkwearmouth Colliery, 1500 feet below the level of the ocean, (depth from surface of ground, 1668 feet), as we were suddenly arrested in our progress by a thundering noise ahead, and obliged to make a hasty retreat in the opposite direction, walking in the shape of fish-hooks, to keep from touching the loose rocks that hung in festoons over our heads, ready to fall with a trifling jar. In another instance, while ascending from one of the Salt Mines, at Northwich, 360 feet deep, there were six persons hanging around the bucket, or rather standing inside and on the edges, when from the conduct of a drunken visiter, the miner who accompanied us trembled like a leaf, and became so weak from fear, that he could hardly hold on till he reached the top, at the same time begging the man to be quiet. But these, and a variety of other risks and adventures, belong rather to a literary than a scientific journal, and I will therefore proceed to the extract in question, describing the manner of constructing, and the expense of the Kilsby Tunnel, on the London and Birmingham Railroad.

The material excavated was a quicksand, and the great difficulty was draining, as the sand becomes fixed when dry. To do this, they attempted horizontal draining, but the drift filling up immediately, they were obliged to resort to pumping, and for this purpose sunk a row of well shafts about four rods (as near as I can recollect) from the line of the tunnel. In some instances, two pumps were worked by one steam engine by long pitmen running in opposite directions, supported on several leading bars. The tunnel when finished has extreme height in clear, 27 feet 4 inches; (?)* span of invert, 22 feet 4 inches; dish of invert 3 feet; (?) extreme width at eight feet above spring line of invert, 24 feet in the clear; above this, the arch has the transverse axis of the semi-oval vertical. The Tunnel near London, through London clay, has full centre, but finding from the nature of the material that something analagous to hydrostatic pressure,

* I am not certain as to the extreme height and dish of invert.

under a height of 60 feet, crushed in the bricks at the crown, they remedied the difficulty by making the arch surmounted, in the subsequent work.

The arches are 18 inches, and invert 14 inches, without bond in the thickness of the arch, but laid in thickness of half bricks, or concentric rings of 4½ inches (a very common arch in England). The side walls are of English bond, and at the intersection of the wall with the invert is placed a freestone skew-back, with face 6 inches in prolongation of face of wall, and beds corresponding with the thickness of the side wall and invert, and normal to their curves; the bottom being level and back plumb. All the rest of the work (except the heads of the Tunnel) is of brick.

Working shafts are found most useful with 9 feet diameter in the clear, walled with two concentric circles of dove-tailed bricks 4½ inches long, making excavation 10·50 in diameter. The wall is put in without curb, and remains where it is first placed, being built upon a wooden ring laid on the bottom. To get down the next length, they support the first piece by four suspenders of two-inch bolt iron, secured in heavy timbers on top and under the ring at bottom. The shaft is then sunk as far as the earth will support itself—another ring put in—the wall built up—(at the same time packing or "punning" in the earth behind it) until it reaches the first piece, when the suspenders are lengthened to support the second ring, and so on to the bottom of the shaft, or top of the arch of the tunnel; where for the time, the wall is supported on a wooden crib until the arch is finished, when a cast-iron curb of 6½ tons weight is masoned into the arch, and the wall built up to the finished wall of the shaft.

In this process, the earth soon binds on the wall, and this leaves but little weight to be sustained by the suspenders.

After reaching the level of the top of the arch, or sufficiently below it to work, they run in a drift. and take out a length on each side of the shaft, and finish it stronger than the rest (except the shaft length which is the same), on arches three bricks, and invert two bricks,=27 and 18 inches thick. The shaft length is then taken out and finished the same thickness as those at the sides, and these three lengths laid in Roman cement. They have then a breast on each side of the working shaft, and when the work is in regular train, the miners and masons work alternately at the two ends, the bankmen above taking up the spoil earth from the miners, letting down bricks and cement for the masons, and timber for the carpenters.

After the first length is finished, and they wish to extend the work, the first process is to drive ahead a drift of four feet wide and five feet high, about four feet beyond the distance they intend to cut down for the next length. The earth in this drift will support itself (otherwise they would have been obliged to make it narrower) until the two beams or "Bars" left above the finished arch at the top of what was formerly a similar drift, can be taken out by means of a log chain attached to the projecting ends, and a jack screw placed against the finished arch. The holes then left by the bars are then filled with earth "punned" in, except near the forward end of the brick work. One end of the bar is then placed in the hole thus left for it, resting on the arch, and the other end supported by a prop raising the forward end a little higher than that on the arch, that it may be drawn out easier when they make the next advance. The roof of this part being thus secured by the two bars (one on each side) kept apart by short straining timbers, the next process is to *widen* the drift on each side as far as they can trust the roof, when another bar is placed in the same manner as before, having one end supported by the arch, and the other upon a prop, and kept from the former by short straining timbers as in the first case. In widening the drift, about four feet of the forward end is left untouched, and the other part on that which is widened, is also dug deeper (say three feet). After advancing in this manner, placing in the bars systematically on each side, the arched form of the roof will in a short time bring it to the bottom of the excavation, and before advancing farther, it is necessary to get lower. To do this, a bench is left where the props stand, and, having excavated the depth intended, props are placed in front of the first, and reaching to the bottom of the new excavation. The first props are then taken out, the bench cut down, and props of the length of the second put in place of the first. The second set of props are then removed, the breast widened as in the former case, and the vault supported by the bars kept in their places by the united support of the arch at one end, the row of props at the other, and the straining timbers between, until they reach the springing line, and then, if necessary, brace the side of the last bar into the offset by short side props. They have thus an entire temporary wooden arch occupying for the most part the place to be filled with brick, for the roof is but about four inches beyond the extrados to give room for punning the earth behind. To finish the excavation, a bench is left for the foot of the props, and the face cut down plumb, and being supported by planks and posts, the braces, or rather shores, extend in, and are secured upon the finished brick work of the invert. The miners having thus finished their work, and the carpenters secured it from falling, we find at the top of the breast, a short piece of the drift, about four feet long, then a face to the springing line (and up the bars along side of the drift) secured by plank, posts and shores. In front of this, and to the same depth, the props of the side bars, while the props of the two upper bars are towards the back of the drift—these two upper bars being also above the arch range of the others, that they may remain above the brick arch until it is closed. The face of the work in front and below the props likewise secured as above.

The masons having at the same time with this operation completed the arch at the face on the opposite side of the shaft, change sides with the miners, and commence their work by laying the invert, and as they build up the walls and the arch, the earth is rammed in behind at every two courses. Proceeding thus, they come to the spring when the centres are plaeed upon, but not connected with the brick work below. The cushions are laid longitudinally, and the courses of the bricks the same, and as they come successively to the bars on each side, they are taken out until they reach the two centre bars, when the work is carried on below them until they come to the closing. As they cannot get *above* the arch to do this, the last cushion on each side near the crown has a rabate cut in the edge, into which short cross cushions are placed, beginning at the end of the opening near the finished arch. A short piece of the arch is then closed, the closing bricks being toothed into the finished work, another cross cushion is then put in, and another short piece closed, and thus they proceed until the whole length of the arch is closed. The centres being struck, we find at the top a small hole below the arch through which the miner enters to commence operations for the next length.

*Expense.* In the sand hills, £22 10s. but ordinary price £16 per yard linear, timber, £2 10s. and carpenters' work £2 10s. per yard, 8,000 bricks and 70 bags of cement per yard, two gangs of four miners, five laborers, two bankmen, two boys and two horses, in a week of seven days, excavate in best running four yards, and in worst two yards. There are 18 working shafts, and average 30 yards per week of seven days. Four masons and ten laborers, exclusive of bankmen, who are also at work for the miners, will brick a length of eleven feet, in from four to twelve days.

Working shaft 129 feet, much troubled with water, was finished in 7 or 8 weeks, at 50 shillings per yard linear.

Iron bolts, strength 25 tons, connect a plate of cast iron near the head of the tunnel, with another plate 100 feet back.

In the United States we have tunnels driven through earth, but I have no certain information as to their cost. The Grants hill tunnel at Pittsburgh, was not constructed by mining, but by a thorough cut filled up after the arch was turned.

The tunnel on the Union Canal in this state, through a tough black shale, much harder to work than sandstone, ends arched, 18 feet span, 6 feet rise, abutments 8 feet high, face plumb, and excavation taken out roughly to same size, was taken originally at $50 per yard linear, abandoned and re-let at $83 per yard—fair price = $2 50 per cubic yard.

Tunnel on the Alleghany Portage Railroad 901 feet long, width of excavation 24 feet, height 22 full centre, material ¾ slate, ¼ sand stone, was taken at $1 47 per cubic yard, and also received 14 cents for it in embankment—fair price, = $1 61 per cubic yard.

In running drifts, at one of the furnaces in this state, they pay $4 50 per yard linear, for a drift 7 by 7, and also $2 00 per ton for the ore averaging 2 tons per yard, material, iron shale, ball and band ore, rather more difficult to work than sand stone, or $1 54 per cubic yard.

In the Schuylkill coal region they pay $10 00 per yard for tunnels, (so called, when they cross the strata.) through coal and sand stone of every quality from the finest up to coarse pudding stone, $2 50 per yard cubic.

As to works in progress, or but lately completed, I consider the information confidential, but, the above will show the range of prices for mining rock, and have been added in this communication for the information of the general reader, to show the public, that although tunnels are expensive and objectionable when they can be avoided, still, that the expense can be calculated in dollars and cents, and that the range does not differ more thaa the prices of open work.

Yours respectfully, B. Aycrigg, *Chief Engineer.*

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## *The Little Miami Railroad.*

To the Editors of the Railroad Journal and Mechanics' Magazine :—

Gentlemen,—In compliance with a general invitation to your subscribers, I will give a brief description of the Little Miami Railroad ; should you think proper, you can modify it, and give it a place in your Journal.

The Little Miami Railroad Co. was chartered by the Legislature of Ohio, at the session of 1835—6, with power to construct a Railroad from Cincinnati to Springfield, Clark Co.—there to intersect the Mad River and Lake Erie Railroad. For a description of the line and merits of both Roads, see Railroad Journal, Vol. II, Part 2d, pages 640 and 644. The line of the Little Miami Railroad passes through the entire valley of the Little Miami River. A valley unsurpassed, if equalled, for agricultural and manufacturing purposes, by any other of the same extent in the United States. The merits of the work are, to any person acquainted with the great travelling thoroughfares of the West, too obvious to require comment. Suffice it to say, that this, in connexion with the Mad River and Lake Erie Railroad, unites the Ohio River and all the travelling thoroughfares of the south and the west with Lake Erie and the Ohio Railroad (which is now being constructed) at the north. All of which, together with the New-York and Erie Railroad, form a continuous line of Railroad from Cincinnati to New-York. After the 22 miles, now advertised, have been let, there will be 15 miles of Railroad completed and in operation, and 40 more under contract to be completed the ensuing year, between Cincinnati and Sandusky City. Respectfully, yours,

R. M. SHOEMAKER.

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*Second Annual Report of the President and Engineer-in-Chief of the Central Railroad and Banking Company of Georgia, to the Directors and Stockholders.* L. O. REYNOLDS, Chief Engineer.

ENGINEER DEPARTMENT, CENTRAL RAIL ROAD;
*Savannah, October* 31*st*, 1838.

To W. W. GORDON, ESQ. *President.*

SIR,—Nearly six months have elapsed since the date of my last Report, and as you are about to leave the city to be absent some weeks, I have the honor to present you the semi-annual report of the operations of this department, and the present condition of the work.

The entire route, hence to the city of Macon, although not definitely located, has been so far determined as can be done by experimental surveys. A particular description of the line, as then located to the point where it passes the Ogechee river, was given in the Report of the 10th of May last. From that point, it follows the valley of Williamson's Swamp, and crosses this stream near the "Double Bridges;" then taking the southernmost of the two southern prongs, ascends to the summit of the ridge separating the waters of the Ogechee, from those of the Oconee, which ridge it crosses about two miles and a half south of the village of Sandersville.

An examination was made of the valley of Limestone Creek, with a view of making the ascent by that stream; but although we shauld have saved about ¾ of a mile in distance by that route, the line would have been objectionable, both in allignment and grades, which latter would have been undulating, and have frequently reached our maximum rate of inclination, while on the line adoptad, we have a regular and gentle ascent to the summit. Having passed the summit, we avail ourselves of the valley of a prong of the head branches of the Ohoopee for a short distance; this takes us to the head of the Sand Hill Creek, by which we descend to the Oconee river. The line down Sand Hill crosses several deep ravines, and cuts off points of hill, involving a succession of heavy excavations and embankments, rendering this part of the grading more expensive than the general average. The distance of this heavy work however, is only about five miles, and will probably not exceed an average of $20,000 per mile.

We reach the Oconee River near a spot called "Rag-point," about three miles above the mouth of Commissioner's Creek, and sixteen or eighteen miles below Milledgeville. The River Swamp is here about one mile wide on the east, and two miles on the west side—for this distance it will be most safe and economical to support the grade, by strong truss work; and if hereafter it should be deemed expedient to substitute an embankment through the whole or any part of the Swamp, the road will afford the means of doing it at comparatively a small cost. The River will be crossed by a Bridge 200 fee in length, supported by stone abutments and a pier in the centre.

The line having passed the River, follows the valley of Commissioner's Creek, which affords a very favorable route. The foundation in the Creek Swamp wherever we touch it, is firm. The line may be located with very easy grades and gentle curves, for the distance of twenty-seven miles up this Creek; at this point and thence to the summit, (5 miles) the country is similar to that described on Sand Hill Creek. We pass the summit dividing the waters of the Oconee from those of the Ocmulgee, at a point 8½ miles from the city of Macon, on the Milledgeville road.

Taking a branch of Walnut Creek, we here commence our descent to the Ocmulgee, which is effected by following the valley of this stream.

The ground is so broken and hilly in this region, that our line is confined to the meanderings of the stream, and consequently varies considerably from a direct course, the curvatures however are generally easy—in no case on a radius of less than 2000 feet. From the summit to the Ocmulgee, we again have an expensive section similar to that down Sand Hill Creek—making altogether about 25 miles of what may be termed (in comparison with the portions of our road now graded,) heavy work. This is no more than we have always expected—and when we look abroad and find that the *average* cost per mile of the graduation of most of the roads in the United States, far exceeds that of our most expensive sections, we have reason at least to be satisfied with the natural advantages which the country affords for the prosecution of our enterprize.

The total distance from the City of Savannah to the City of Macon by our line, as above described, is 196 miles. Only 112 miles however being definitely located, there will probably in the remaining portion be some reduction of distance, occasioned by substituting curves for angles, and making slight changes and improvements in the experimental lines.

It was believed by many individuals of respectability, residing in Milledgeville and its vicinity, that our road might cross the Oconee River within a short distance of that place, not only without any material increase of distance, or cost, but with great advantage to the interests of the company as well as benefit to that section of country; and the Board of Directors being desirous that an examination should be made to ascertain whether any advantage would result to the company from such a location, an exploration and instrumental survey was accordingingly made with that object.

The result was an increase of *twelve miles*, and as the point of divergence from the Commissioner's Creek line was above the most favorable portions of that line, and the route thence to the mouth of Camp Creek being through a very unfavorable country for a rail-road, we should, in addition to the increase of distance, exchange twenty miles of very favorable line, for the same distance of very expensive, making nearly the whole distance from Macon to the Oconee, heavy and costly work.

The comparison would stand thus:

*By the Commissioners' Creek Line.*

From the point of divergence to the Oconee Swamp, 20 miles of grading at $4000,..................................$80 000
Crossing the Oconee Swamp 3 miles, $10,000,................30 000
Bridge over the Oconee River,.............................20 000

Total,..................................$130 000

*By the Camp Creek line.*

From the point of divergence to the mouth of Camp Creek, 20 miles of grading at $25,000..........................$500 000
Bridge over the Oconee,....................................20 000
15 miles of grading down the north side of the Oconee, at $4000,.................................................60 000

$580 000

Difference in cost in favor of the Commissioners' Creek route, $450 000

To sum up the comparison of the two routes, we have in favor of the Commissioners' Creek line,

1st. An advantage of 12 miles in distance.

2d. A difference of nearly Half a Million Dollars in cost.

3d. An advantage of a gentle and nearly uniform grade down Commissioners' Creek, while on the other line we are obliged to undulate to the extent of our maximum rate of inclination, for nearly the whole distance.

4th. By taking the Camp Creek route, we should violate a provision of our Charter, which requires us to pursue the *shortest practicable route from Savannah to Macon.*

The following extract from the Report of Mr. Randolph Coyle, Assistant Engineer in the service of this Company, who made the surveys, more particularly describes the character of the country and the route surveyed.

"The survey of the route to pass in the vicinity of Millegeville, (via Camp Creek, &c ) was commenced at that point upon our Commissioners' Creek line, where it is crossed by the Millegeville and Marion road. Going thence towards Millegeville, we cross first, the ridge separating the north and south branches of Commissioners' Creek. The crest of this ridge is uneven. The entire country between the north and south branches of Commissioners' Creek, is broken by numerous deep vallies of small streams. The Marion road passes this ridge at about the most advantageous point. On the west of the road, the ridge rises rapidly, and becomes broken; on the east of it also the ridge is high and broken, to the very junction of the two branches of Commissioners' Creek. Our survey was conducted, as far as the north branch of Commissioners' along this road, a cross line being run upon the crest of the ridge, for some distance on each side of the road, to ascertain whether or not a more favorable passage through the ridge existed.

"Arrived at the north branch of Commissioners', it became necessary to ascend from its valley to the head of Camp Creek. The country affords no stream whose valley will conduct us to this point, except Beaver Creek. The sources of Beaver Creek interlock with those of Camp Creek and Black Creek; it empties into the north branch of Commissioners, about 2¼ miles below where our line first attains the valley of that stream. Our line descends the valley of the north branch, to the mouth of Beaver Creek, and ascends the valley of this latter stream.

"As Beaver Creek enters the north branch very obliquely, we were desirous, if possible, to establish our line directly across the ridge dividing them, and, to ascertain the practicability of this, traced a compass and level line along the crest of that portion of the ridge which could come within the range of our operations. The result showed us that the ridge was impassable, except at an expense of high grades and deep cutting, more than equivalent to the increased distance by the valley line.

"Beaver Creek has an eastern and a western branch, the vallies of both of which were occupied by our lines. The western branch heads within one fourth of a mile of the head of Camp Creek. The summit to which it conducts, is narrow but very high. The eastern branch, conducts not immediately to the head of Camp Creek but to the head of Black Creek, a stream which empties into the Oconee, about half way between Camp and Commissioners' Creek. The ridge between the heads of the western branch and Camp Creek, is, however, 80 feet higher than that between the eastern branch and Black Creek, or that between Black and Camp Creeks. The distance is very nearly the same by both branches to the head of Camp Creek. From the head of the eastern branch of Beaver Creek, the line crosses to the eastern slope of the dividing ridge between the Oconee and Commissioners' Creek, and runs northward about 1½ miles to the head of Camp Creek. For the greater part of this distance of 1½ miles, the line occupies the vallies of two small streams, heads of Black Creek, which run, the one in a northward, and the others in a southward direction; the first having its source very near that of the eastern branch of Beaver Creek, and the second rising near the heads of Camp Creek and the western branch of Beaver. Crossing from the head of Black Creek to the head of Camp Creek, the line pursues the valley of this last stream, along its northern bank, to its mouth, about one hundred yards above which it crosses the Oconee. Thence it descends the Oconee to within 1½ miles of the point of high ground, dividing its valley from that of Buffalo Creek. There is here a very low pass through this ridge, which the line occupies, and connects with an experimental line run by yourself in the valley of Buffalo Creek, near the road leading to the Buffalo lower Bridge.

"The average fall of the valley of Camp Creek, would give a tolerable high grade, could one uniform grade be established from its source to its mouth. Its fall is, however, very unequally distributed throughout its course, being, near its head, extremely rapid, and comparatively gentle as it approaches the Oconee. A line even tolerably cheap near the head of this stream, would require far steeper grades than 30 feet per mile. It would be possible, by cutting from 40 to 50 feet at the head of the stream to descend it with a grade of 30 feet per mile, which would eventually bring the line down to the bottom of the valley; but such a line would, of course, involve the necessity of very high embankments across the vallies tributary to Camp Creek, and of very deep cuts through the ridges separating those vallies. When it is remembered that the very great elevation of the short summit, (that at the head of the western branch of Beaver Creek,) compelled us to adopt for our ascending line the eastern branch of that stream, and to attain the head of Camp Creek by means of the vallies of small heads of Black Creek, it will be perceived that the necessary cut at the head of Camp Creek must be as long very nearly, as the whole summit section—one mile and a half. There is a small portion of this section where a line could find, in the vallies of the Black Creek branches, ground low enough to avoid heavy cutting.

"The general character of the country between Commissioners' Creek and the Oconee, with the exception of a part of the valley of Camp Creek, is similar to that of the summit section of our Walnut and Commissioners' line. The surface soil is light sand, beneath which is stiff, hard clay. This would probably be the only material to be encountered in the cuts through the ridges between the north and south branches of Commissioners' Creek, between the heads of Beaver and Black Creeks, and between the heads of Black and Camp Creeks. About six miles below the head of Camp creek, that stream enters the Mica Slate. From this point to the Oconee, we should probably have to blast the rock in every excavation. The expense of blasting is not the only evil we would have to encounter in consequence of this rock. Its effect upon the character of the valley is, from obvious causes, very unfavorable to us. It renders the stream crooked. Little or no alluvial flat occurs along the stream below where it enters the rock, but the hills, alternately gentle and abrupt on opposite sides, slope down to the channel. From these causes the most favorable part of the line in this portion of the valley must be—the allignment, a series of reversed curves—the graduation, a succession of cuts through the points of the hills where they advance into the bends of the stream, and embankments across the heads of the basins little which are formed between those points of hills. These cuts and embankments will be less in proportion, as the radii of the curves are reduced. The unfavorable line in this portion of the valley, will be at those points where the rocky hill side makes a steep bluff to the stream.

"The site at the mouth of Camp Creek is most favorable for a viaduct. The average depth of the river at its lowest stage is here about 8 feet. The bottom is of solid rock. The banks are high. There is no swamp.

"From the crossing of the Oconee to Buffalo valley, the line is as favorable as could be desired, with the exception of one point, which is where Town Creek empties into the Oconee. These streams here form a large swamp which runs up into the country, like a bay, for a considerble distance. To cross it would require an embankment averaging $5\frac{1}{2}$ feet high for $1\frac{1}{2}$ miles.

"That there might be not the least doubt concerning our ability or inability to cross from the valley of Camp Creek to that of Fishing Creek, at Milledgeville, a line was run, to obtain the profile of the ridge separating those streams. The result showed that its elevation at the lowest point was 125 feet above Camp Creek valley, where it was proposed that we should leave that valley. The average distance between Fishing and Camp Creeks for three miles above the mouth of the latter, and two miles above the mouth of the former, does not exceed two and a half miles. Any cut through the ridge must be mostly through solid rock.

"I am satisfied that every attempt to cross the ridge between the two branches of Commissioners' Creek, or that between that Creek and the Oconee at points farther north than our experimental line, would succeed only in encountering a much higher and more broken country."

It may be proper here to mention, that the country on the East side of the Oconee affords a most favorable route for the construction of a Rail Road from Milledgeville to our line. The grade would be almost one uniform inclination, and the low lands bordering on the Oconee Swamp would require but little excavation and embankment to form the road bed.

The grading of our road is now under contract to a point 112 miles from the Depot in this city, and the contractors are bound to complete it to that point by the first of March next.

The timber for the superstructure is laid for the distance of 55 miles, and progressing at the rate of five miles per month.

The iron is laid and the road completed 46 miles. Our Engines now run daily with the Macon Mail and Passengers to that point.

The bridge over the Little Ogechee is finished, and the grading, including most of the bridges and culverts, done for a distance of 79 miles.

The force now employed on the line is about 500 men, and the contractors are daily augmenting their forces, so that we shall probably in a short time have three times the present number.

It is worthy of remark, that there has not been a contract relinquished or abandoned, since the commencement of the work.

We have commenced the erection of the machine shops at the Depot in this city, which are to be of brick, and on a scale suited to the magnitude of the enterprize.

A further distance of fifteen miles of grading is advertised for letting on the 1st of December, which will extend our work 127 miles from this city.

I have often been asked the question, "why do not the Company commence work on the upper end of the line?" Such a desire no doubt exists with many persons deeply interested in the success of the undertaking, residing in that part of the country; but it is presumed they are not aware of the difficulties attending such a course.

If our operations, which are at present widely extended, were so far enlarged as to embrace any portion of the farther extremity of the road, a separate establishment and organization of supervision and superintendance would be unavoidable. The Engineer Corps would require to be increased, and whatever work might be done, would not only be unproductive of profit to the Company, but the excavations and embankments being exposed to the weather, would by washing, deteriorate 8 or 10 per cent before they could be brought into use. It will not for a moment be supposed that it would be expedient to haul the iron for the tracks in wagons, or even ship it *via* Darien for Macon; such a course would add greatly to the cost without any equivalent benefit. By our present arrangement, the iron and other materials, as also most of the supplies to contractors are carried forward by our Locomotive Engines, and the freight and passage money collected, not only defrays the expense of this transportation, but already nearly pays the expense of our mechanical establishment at the Depot in this city.

The advantages of keeping up a communication from this end of the line as we advance with the work, and of finishing the work continuously, I am persuaded will strike any one who will take the trouble of reflecting on the subject.

I had intended to present you an estimate of the cost of the whole road in this Report, but the time since the completion of the explorations and surveys determining the western end of the line has been so short, that the necessary computations for a careful estimate could not be made. These surveys, however, have not developed any facts leading me to believe that the work will cost more than the original estimate made by Col. CRUGER, which you will recollect was a little over Two Millions of Dollars.

For a view of the whole route herein described, I refer you to a map which I now hand you, on which it is laid down in a red line, with the topography of the adjacent country, on a scale of 200,000 feet to one foot, or about three miles to one inch.

The surveys detailed in the Report, of the line passing near Milledgeville, are also laid down in a blue line on the same map.

Iam, Sir, very respectfully, your obedient servant,

L. O. REYNOLDS, *Chief Engineer.*

(From the Journal of the Franklin Institute.)

## *Protection of Iron by Zinc.*

The invaluable discovery by Mr. Sorel, of an effectual and cheap method of preserving iron from rust, or corrosion, by zinc, described in a recent number, has occasioned the formation of a Galvanized metal company for the manufacture of zinced Iron, and the extension of its use throughout Great Britain. The happy solution of this long sought chemical problem, which will doubtless be productive of immense economy in the use of a metal, the demand for which must continually increase faster than the possibility of its adequate production, must hereafter constitute, like the steam engine, one of "the most valuable presents from philosophy to the arts." The following testimonials to the soundness of the principle and value of the discovery, are from the prospectus of the English, Scotch, and Irish Galvanized-metal company. G.

M. Sorel, a French chemist, after many years of study and experiment, discovered an application of a scientific principle of preventing the oxydation or destruction of metals. particularly iron, as effectual as it is simple and inexpensive. His discovery is protected by a patent in France, where, for some months, the process has been in successful operation. Patents have also been granted for the invention in the United Kingdom.

The discovery has been submitted to the consideration of the following eminent British chemists:—W. T. Brande, F. R. S., Professor of Chemistry to the Royal Institution; J. G. Children, F. R. S.; Thomas Graham, Professor, London University; A. Garden, M R. I.; Richard Phillips, F. R. S.; and such of the Reports of those gentlemen as have been received are annexed.

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### *By Professor Graham of the London University.*

The effect of zinc in protecting iron from oxydation has been known to chemists for some time. When these two metals are in contact, an electrical or galvanic relation is established between them, by which the iron ceases to be susceptible of corrosion by dilute acids, saline solutions, or atmospheric humidity. It was found in experiments lately conducted at Dublin and Liverpool, that small pieces of zinc attached to each link of a chain cable were adequate to defend it from corrosion in sea water. The protection was observed to be complete, even in the upper portion of the iron chains by which buoys are moored, and which from being alternately exposed to sea water and air is particularly liable to oxydation, so long as the zinc remained in contact with the iron links. The protecting influence of the zinc could not be more certainly secured than in the articles prepared by the patent process, the iron surface being uniformly coated over by that metal. In trials, to which I have had an opportunity of subjecting them, the iron escaped untouched in acid liquids, so long as a particle of the zinc covering remained undissolved. The same protection is afforded to iron in the open atmosphere by zinc, with a loss of its own substance, which is inappreciably minute. The zinc covering has the advantage over tinning, that although it may be worn off and the iron below it partially exposed, the iron is still secured from oxydation by the galvanic action, while the smallest quantity of zinc remains upon it; whereas tin in common tin plate, affords no protection of this kind, and not being absolutely impermeable to air and moisture, the iron under it soon begins to rust in a damp atmosphere. The simplicity and perfect efficacy of the means employed to defend iron from the wasting influence of air and humidity in this process of zinc-tinning, certainly entitle it to be ranked as one of the most valuable economical discoveries of the present age.

THOMAS GRAHAM,
*Professor of Chemistry.*

University College, London, April 17th, 1838.

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*Jointly by J. G. Children, Esq., F. R. S., &c., and A. Garden, Esq., M. R. I. &c.*

The so-called galvanized iron consists of iron coated by zinc. The process by which the union of these two metals is effected we are ignorant of, as we have not seen a copy of the French patent, but we conclude that it is somewhat similar to that by which iron is coated with tin, since, that zinc may be so employed instead of the latter metal was pointed out by the Messrs. Aikin in their Dictionary of Chemistry, as long ago as the year 1807. The method adopted by Sir H. Davy, for protecting the copper sheathing of ships by means of some metal whose electrical relations are positive with respect to the copper, may have suggested the idea of a similar protection to iron, and it is obvious to theory, and demonstrated by fact, that zinc is an incomparably more powerful agent in producing that effect than tin. A material difference, however, exists between the French invention and that of Sir H. Davy, since the English philosopher employed *contact* of the metals only in protecting copper; whereas Monsieur Sorel avails himself of the chemical (or electrial) affinity of the metals in the most extensive and perfect contact in protecting iron.

Certain specimens have been shown to us as the results of comparative experiments made by exposing articles formed of galvanized iron, and similar articles of tinned iron, and of iron in an uncovered state, for several months, to the influence of the atmosphere, in which the iron of the first remains unaffected, whilst that of the two latter is very much oxydated. Time has not been allowed us to repeat this, the most simple and most conclusive experiment; but, those which we have been enabled to make in the short interval that has elapsed since our opinion on the merits of this invention has been demanded, give us every reason to believe that the results alluded to have been honestly obtained, and that they afford decisive evidence of the efficacy and importance of this method of protecting iron from rusting influences.

The experiments we have made consisted in exposing plates of galvanized iron, and similar plates of tinned iron, and of iron altogether unprotected, in separate vessels, to the action of distilled water, a solution of common salt of about the same strength as sea-water, and of diluted muriatic acid. In every case, the unprotected iron and the tinned iron were acted on and oxydated in a very few hours, and in three days abundance of red oxyde of iron was found to have been deposited in each vessel containing the iron plates and the tinned iron plates; but in those containing galvanized iron not the slightest trace of red oxyde could be detected, and, except an almost imperceptible discoloration of the zinc surface, which in one or two instances had become a little darker, the galvanized iron was entirely unchanged. A piece of galvanized iron plate and of simple iron plate were also placed *in contact with each other* in distilled water, and another similar pair in a solution of common salt. In three days neither plate showed any symptoms of the iron having been oxydated, so that the protecting power of the zinc of the galvanized iron plate appears to have extended to the iron plate in external contact with it also. It had been suggested to us that perhaps accidental or partial abrasion of the zinc surface might occasion the iron to rust into holes where unprotected. We did not think this likely, nevertheless, we put it to the test of experiment, and with a file cut lines into the galvanized plate entirely through the zinc, so as to leave the surface of the iron exposed, and did the same with a plate of tinned iron. In every instance the lines in the latter were filled in a day or two with red oxyde of iron, while those in the galvanized iron plate retained their undiminished metallic brightness. We did more,—we dissolved off every particle of zinc from two portions of the galvanized plate—in one case by very dilute muriatic acid, in the other by equally dilute sulphuric acid. As soon as the whole of the zinc was removed, the solution was poured off, and a portion of it, to which some nitric acid was previously added, was tested for iron by pure ammonia; when the only evidence that any portion of the latter metal had been dissolved, was a very faint reddish tinge which prevailed through the liquid, but so slight as hardly to afford a sensible precipitate of light floculent particles, after considerable repose. With the evidence of these facts before us, we can have no hesitation in stating our opinion that this method of protecting iron from rust will prove of infinite service in a variety of arts, and will admit of economical application in numerous ways, as the roofing of buildings, sheathing and bolting of ships, and a thousand other forms, and entirely supersede the employment of tinned iron, except in vessels used for culinary purposes, in which, we fear, it could not safely be adopted. It is possible that the objection to the use of H. Davy's protecting copper for the sheathing of ships, may also prevail against the employment of the galvanized iron for the same purpose,—the increased tendency to foulness from the adherence of barnacles, weeds, &c., to the ship's bottom; at the same time we think it probable that it may not be liable to that drawback; but this question must be referred to the only satisfactory solution—*experiment.*

J. G. Children,
A. Garden.

London, 17th April, 1838.

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*By William Thomas Brande, Esq., F. R. S.*

Royal Mint, 26th April, 1838.

Gentlemen—I have examined the several articles sent to me by your order, under the name of *galvanized iron*, and represented as manufactured of iron in various combinations with zinc. In this way an arrangement susceptible of electric excitation is obtained, in which consistently with the laws of electro-chemical action, a preservative power is conferred by the zinc upon the other metal; for in all cases in which two different metals are in contact, a current of electricity may be established in them in such a direction as to protect the least oxydizable of the two metals.

In common tin-plate, or tinned iron, the combination is such that the oxydizement, or corrosion of the iron, is accelerated by the tin, so that *iron* is the *protecting* and the *tin* the *protected* metal; but in the case before us, in which the respective metals are iron and zinc, the reverse effect ensues, the *iron* is here the *protected* metal, and *zinc* the *protector*; and, consequently, when these latter combinations are subjected to the action of water and other agents, the iron is preserved from corrosion so long as any zinc remains to maintain the electrical current.

I have subjected pieces of this prepared iron to the action of distilled water, to rain water, to sea water, to the joint action of air and water, to dilute solutions of sulphuric, nitric, and muriatic acids, and to other oxydizing or corroding agents upon the common tin plate and upon wrought and cast iron, and, as was expected, the rusting and corrosion of the iron, is in all these cases entirely prevented in the zinced, or patent plate; whereas, on the other hand, it goes on with more or less rapidity in regard to the unprotected, and the tinned iron; and, as respects the latter, the iron, whenever it is exposed, appears to be more rapidly corroded in consequence of the adjacent tin.

As far, therefore, as under these circumstances the relative durability of the patent iron as compared with either wrought, or cast iron, or with tinned iron, is concerned, permanence is excessively in favor of the former; and there can be no doubt of the great advantage that must accrue in a vast number of the ordinary applications and uses of these substances, in the employment of the zinced, or patent plate, and in its substitution for any of the usual forms of manufactured iron.

As my experiments have necessarily been limited in regard to time, I cannot speak with certainty as to effects which may possibly ensue from the protracted action of chemical agents upon the zinced iron; but both theory and experience lead me to believe that so long as the zinc endures, the protection will hold good.

Again, speaking theoretically, I should presume that the zinced plate, or the other forms of the protected iron, would be admirably adapted for roofing materials, gutters, water pipes, chimney tops. packing cases, and all analogous applications in which a light and durable material that will resist the joint action of air and water is required; that it would also be well adapted for certain tanks and cisterns; for the manufacture of a great variety of articles required to endure a damp atmosphere, such as locks, keys, hinges, &c.; for cellars, warehouses, and all exposed situations; and for the iron-work of bridges, canal locks, and of much other machinery; for the beams and columns of buildings; for clamps, bars, rails, bolts, nails, screws and nuts; for all out-door works; and for many implements in, and parts of chemical and other manufactories. In short these applications are as obvious as they are endless.

On the whole, I regard this as by far the most valuable practical application of the electro-chemical principle of the protection of metals which has hitherto been carried into effect.

I am, gentlemen,
Your faithful servant,
William Thomas Brande.

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In addition to which indubitable opinions, the following translated extracts from the French Society are corroborative and interesting.

"Chemists have long attempted to apply electricity by perpetual contact to the preservation of iron; but the means employed were defective and unsuccessful, until the recent discovery by M. Sorel. Sir H. Davy died with the conviction, that the application of the principle was possible, and would some day be attained.

"Science has already given testimony in favor of M. Sorel's process. Messrs. Dulong and Dumas have frequently alluded to it in their addresses to L'Academie des Sciences.

"The following extract is from a Report made to the General Meeting of La Société d'Encouragement, at which Baron Thenard presided on the 5th July, 1837.

"'The experiments of several members of the Committee of the Chemical Arts have proved that M. Sorel's process effectually protects iron from oxydation. It is, therefore, to be expected, that the galvanic coating will soon be applied not only to the sheet-iron but to many of the larger masses of that metal, cast or wrought, which are employed in naval architecture, military implements, and domestic buildings, especially to the iron-work of shipping exposed to the atmosphere, or to salt water; to war projectiles, to masses of iron buried in damp situations, or covered with plaster.

"'The Galvanic Paint is well adapted to all articles of iron exposed to the action of the air or water, or both alternately.'"

*Extract from the Report of L'Academie des Sciences.*

Paris, 11th April, 1837.

"M. Dumas read a Report, by which it appeared that various trials had been made by Sir H. Davy and other chemists to preserve iron from rust, but that none had succeeded. He at the same time read a letter from Captain Born, (of the Artillery of France,) addressed to the Academy, calling their attention to the vast importance of this discovery in its applicability to military purposes only. In giving the substance of Captain Born's letter, M. Dumas said, 'the military and naval artillery had a stock of 7,734,000 projectiles of the value of 26,000,000 francs (1,100,000*l.* sterling.) According to Captain Born's estimate, a pile of cannon balls, after twenty years' exposure to the open air, are almost all unfit for service. If it be admitted, as it must be, that the value of a projectile, sold as cast iron, is not more than one-third of its cost price, then is the importance of this discovery apparent. Supposing that the government of France should adopt M. Sorel's process, the expense of which is very trifling, it then would appear, from Captain Born's calculations, that a saving of 17,333,334 francs, for this part alone of the war department, would accrue in twenty years.'"

The Patent Process may be applied in three different ways, all equally simple:—

1. By coating iron with zinc in a fluid state.
2. By applying a paint made from zinc.
3. By covering with a powder made from zinc.

Under the first process, many articles, not already referred to, will occur to every one considering the subject. Gas-pipes, water-pipes, rails, for tram-roads, iron-bridges, iron boats, roof-gutters, iron-railing, interior of steam-engine boilers; iron sheathing of ships, ship's bolts, &c. On the applicability of the patent process to the three last mentioned articles but little, if any, doubt exists in the minds of our most eminent chemists. The difference in the cost of a seventy-four gun ship between iron and copper would be as 810*l.* to 6480*l.* The saving in her Majesty's Navy and in the Mercantile marine of this country would consequently be enormous.

Under the second process, zinc paint would be employed wherever the bulk of the article to be protected or the difficulty of displacing it would render an immersion of iron into the heated metal impracticable. Bridges, therefore, already constructed, boats already built, in short, all articles already fixed may be preserved from further decay by the use of the patent paint. This paint will not be dearer than white lead.

By means of the third process, the finer sorts of iron and steel will be preserved. All articles of hardware and cutlery are subject to the most serious deterioration by exposure to moisture; but, by applying to them the Galvanic powder, or wrapping them in paper prepared with it, they may be exposed with safety to any weather, or exported with security to any climate.

It remains only to repeat that the processes are not expensive. However numerous and important are the admitted advantages of these discoveries, they would be less striking were they to be obtained only at a high price. The process of coating with the metal in a liquid state is cheaper than tinning. Tin is worth 98s. per cwt., zinc 20s. per cwt. Supposing that galvanized sheet iron should be sold at the price of tin plate, the profit would be, at least 100 per cent.—*London Mech. Mag.*

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## *Signor Pistrucci's new method of striking up Medals without the aid of engraving.* By Wm. Baddeley.

Signor Pistrucci's first application of his new process, has been in striking up a seal for the Duchy of Lancaster. This seal is four inches in diameter, of sterling silver; one side presents a very beautiful equestrian figure of her Majesty Queen Victoria, surrounded by a bold inscription; on the reverse, the arms of the Duchy are richly emblazoned, in the midst of a profusion of scroll-work, with an inscription. To have *engraved* the two dies for striking up this seal, would have taken about fourteen or fifteen months hard labor, with the risk at the end of that time, of the dies breaking in the process of hardening. By Signor Pistrucci's method, they have been produced in less than fifteen days.

There is an exquisite softness, and a boldness of relief, in many parts of this seal not attainable in an *engraved* die; the graceful flowing of the drapery, the prominence of the arm of her Majesty, as well as the ear and hoofs of the horse, are altogether unrivalled. The fame of Signor Pistrucci's success has drawn to the Mint, most of those who are celebrated for their practical acquaintance with the powers and properties of the metals, and with mechanics generally; one and all of whom have expressed themselves astounded at the results obtained. When such gentlemen as Bramah, Maudslay and others, state, that nothing short of seeing with their own eyes would have satisfied them of the possibility of such a work, incredulity may well be pardoned in those who have not witnessed the recent production. There are plenty of workmen in the Royal Mint, well versed in all the methods employed at the *Soho* for the last fifty years, and they all agreed in designating Mr. Pistrucci's plan, when first propounded to them,—as a *new fangled and impossible scheme*, and yet have these very workmen themselves since proved its *possibility*.

The outline of Signor Pistrucci's plan, is tolerably well explained in the *Times* newspaper; the subject is modeled in the usual way, either in wax, clay, or other fit material, from which a cast is taken in plaster of Paris. The plaster cast being hardened, is moulded in fine sand with great care, and a cast, in iron, is taken from it. The great *secret*—if there can be any secret in what has been published in the leading journal of the day, and thence very extensively copied into other publications—consists in the *thinness* of the *iron castings*. The plaster of Paris model is left only about one eighth of an inch thick, the consequence of which is, that the *chill* which takes place on the *surface* of all iron castings, from the proximity of the two surfaces in this instance, pervades the whole mass, giving it the hardness of a hardened steel die, with a toughness, not attainable by the latter metal while in a hard state.

In all large castings, the contraction of the mass of metal in cooling causes a shrinking of all the finer lines, while in thin casting, the sharpness of every line is preserved with surprising beauty.

The iron casting having been made perfectly flat at the back, a hollow is turned out in a steel bed to receive it, and when thus mounted it is ready for use. One proof among many others, of the extreme hardness of the cast iron dies, is afforded by the fact that no extension of the metal takes place from the severest blows: the die fitting no tighter into its bed after striking up a medal, than it did before. The seal before alluded to, took upwards of one hundred and fifty blows from the most powerful press in the mint, and the dies appear in every respect as perfect now as when first cast.

Many persons, who, from their known celebrity and eminence in the scientific world, would be considered the very highest authorities that could be cited in a question of this kind, have not only on examination admitted the *entire novelty* and great importance of this process, but have charged Signor Pistrucci with injustice to himself, for neglecting to secure the privileges of a patent. This, however, the Signor has from the first declined to do; choosing rather to throw open the result of his (miscalled) "hours of idleness," for universal public benefit.

What the real value of this discovery is—or where the useful application of the fact thus established will stop, it is at present wholly impossible to imagine. The advantages of being able to produce at so little cost, and in so short a space of time, the most perfect and beautiful designs—or to copy with so much facility the choicest productions of others, are altogether incalculable. One drawback, perhaps, is the power thus placed in the hands of the fraudulent copyist, and the spurious coiner; but the knowledge of an existing power to do certain mischiefs generally produces an antidote sufficient for the evil, and it is to be hoped the present case forms no exception to the rule. One happy effect of the general introduction of this method of obtaining *dies*, will be to make the *die-sinkers* more of *artists* and less of *mechanics*, to wield the graver *less*—but the pencil *more skilfully*. Should my endeavors to render this useful process intelligible, not be sufficiently explicit, I shall have much pleasure in affording any additional information that may be thought necessary.—*London Mech. Mag.*

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## *Abstract of Papers Read at the Institution of Civil Engineers.*

(Continued from page 292.)

"On the Evaporation of Water from Steam Boilers; by Josiah Parkes."

This paper contains the result of various experiments, conducted with the view of ascertaining the quantity of water which can be evaporated under particular circumstances by a given quantity of fuel. The results are tabulated with great accuracy, and all the authenticated data known to exist on this subject are brought together in a form in which they may be generally useful.

The author was induced to make sundry experiments on the supply of fuel and of air to the furnaces of the engine, with the desire to consume or diminish as much as possible the smoke and soot emitted from the chimney.

The furnaces had hopper mouth-pieces, with a provision for admitting a thin stream of air over the mouth-pieces into the fire, in order to consume the smoke; but which was of very little service, as volumes of smoke rolled forth from the chimney at each successive firing. Heavier and less frequent firing was adopted, and at the same time a careful admission of air over the hopper into the fire; but still the nuisance remained undiminished.

From the researches of Sir Humphry Davy on the safety lamp and on flame, it occurred to Mr. Parkes that the air must be given directly to the uninflamed gas at the point of greatest heat, the temperature of incandescence being necessary for inflammation; whereas, formerly, the air had become vitiated by passing over inflamed fuel, and that the bridge of the furnace was the most fit place for the supply of air, as it would there encounter all the inflamed and uninflamed gas, and obtain at all times the temperature necessary for ignition. Previously to the necessary alterations of the furnaces, the duty done by the coals, as ascertained by the evaporation of water, was carefully registered.

In respect to the firing of furnaces, the author had observed that somewhat less smoke was emitted from less frequent than from very frequent firing, and that somewhat more water was evaporated by the same weight of fuel in the former than in the latter case. Also, that in consequence of less poking, fewer cinders were made; the dampers were lower, as there was a greater mass, though less intensity of heat; and the temperature of combustion being less elevated, there were fewer scoriæ. The operations of firing were gradually diminished, until a mode of working the engine with two charges of coal per diem was arrived at, the furnaces being loaded in the morning as rapidly as keeping up the steam would permit, with sufficient coal to work the engine till dinner-time. The grates were then cleaned, and charged again during the dinner-hour, requiring no more coal during the day. The results attending these alterations were most important, viz., economy of fuel, steadiness of steam, much less smoke, still fewer scoriæ. On the re-construction of the furnaces necessary for the admission of air at the bridges, the whole capacity of the furnaces were enlarged, that they mght contain at once the entire of the fuel requisite for the day's consumption. At the same time the boilers were covered with double arches of brickwork, leaving an air space between each arch and the boiler, coating the outer arch thickly with strong hair mortar, mixed with waste of wool. Eye-pieces were also made in the walls at the end of the boilers, opposite the fire doors, to obtain a view of what might take place at the bridges on opening or shutting the valves; also eye-holes for the side flues, to ascertain how far the flame extended. The results were now of the most satisfactory nature, no smoke being visible from about seven in the morning. The dampers were very close down, and capable of keeping the steam so steady, that it did not vary one-eighth of an inch in height for many hours. The furnaces, when charged, may be considered as great reservoirs of fuel, in a constant, equable, but moderate state of combustion, not the entire mass on fire at once, but distilling first its gaseous products, and then gradually entering into combustion.

The greatest evaporation which was obtained from 112 pounds of coal was 18·5 cubic feet, supposing the water to have entered the boiler at 212 degrees. This was accomplished with both Netherton and Newcastle coal, the Wednesbury giving something less; whilst, before the introduction of the above-mentioned advancement, twelve cubic feet was the greatest evaporation.

This method, which had been followed so successfully, was subsequently made the subject of a patent, and applied to above 500 furnaces; but has gradually fallen into disuse, from its not being worth the master's care and time to see that the firemen do their duty. The author details a conversation which he had with Sir Humphry Davy, who had been making experiments on the temperature at the bridge, and the gaseous products of combustion; during which, that distinguished philosopher gave it as his opinion that the plan could never be established in general practice; that it was too simple, and depended on the fireman and not on the master, who will not concern himself with saving a few coals; that the same was his safety lamp; one half of the miners will not use it, but persist in working comparatively without light, and in danger of explosion, rather than adopt a simple contrivance which requires a small amount of trouble and care.

The paper is accompanied by four tables, the first of which contains the experiments made by himself; the second, the results of the Cornish boilers, from Captain Lean's report; the third, those of locomotive boilers, from De Pambour's work; and the fourth is a comparative table of the mean, greatest, and least results of the experiments on the three classes of boilers. The temperature of the water being different in the various experiments, a common standard is introduced by calculation, and the numbers express the quantity of water of 212° Eahrenheit, which would be evaporated by a given weight of coal.

| | Cubic Feet. |
|---|---|
| The mean value of 112 lbs. of coal in evaporating water of 212° Fahrenheit is in the Cornish boiler . . . . | 21·16 |
| Mr. Parkes' Experiments at Warwick . . . | 18 5 |
| ——————— in Lancashire . . . | 13·49 |
| Ordinary boilers, and system of firing. . . . | 14 |
| Locomotion . . . . . . . . . . . | 10 |

Thus the efficiency of boiler being measured by the quantity of water evaporated by a given quantity of fuel, it appears that the boiler of the locomotives, is far the lowest in the scale, and the Cornish engines the highest. The paper concludes with a review of the state of our knowledge on the application of heat, and on the value of different kinds of fuel.

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"The Land Surveyor's Calculator; by George Heald."

The instrument to which the above name is assigned, was invented for the purpose of avoiding the necessity of performing long arithmetical calculations in surveying estates, the results being given at once by the adaptation and inspection of the instrument, as directed. It may also be applied to extracting the square roots of numbers, and the other purposes to which Gunter's scale is applicable.

The instrument consists of five concentric circles, whereof the four inner ones are on the outer edge of a card, moveable about a centre, and the fifth or outer circle is fixed.

The circumference of the fixed circle is divided into 1,000 logarithmic portions, representing links, and numbered 10, 11, 12, at every ten divisions, which numbers represent 1 chain; 1 chain, 10 links; 1 chain, 20 links, &c. From 1 chain to 1·5 chains these divisions are each subdivided into five parts, which serve to indicate the proportional parts of a link.

The next circle, formed by the graduated edge of the moveable piece of card-board, is in all respects similar to the first, save that the divisions are carried round in the opposite direction. The second circle on the moveable card-board represents areas and decimals, commencing with half an acre, and proceeding up to five acres.

The next circle divided into perches, to correspond with the preceding decimal division. It is numbered at every ten perches, and the acre is expressed at the termination of every rood.

The last, or fifth circle, is to show the area in acres, roods, and perches; when it is under two roods, it is numbered accordingly.

The author then describes the method of using the instrument for the solution of questions similar to the following. Having the diagonal and the two perpendiculars of a quadrilateral, or the base and perpendicular of a triangle; to determine the areas of the respective figures. The result is known at once in acres, roods, and perches, on inspecting either the fourth or fifth circle, according as above the area is greater or less than half an acre.

The instrument may also be used to the computing square yards, to the extracting square roots of numbers, and the ordinary operations of multiplication and division in the same manner as on other logarithmic lines.

A great advantage of this instrument results from the graduation being on the circumference of a circle. Great enlargement of the divisions is thus obtained, and in a far more convenient manner than by drawing a slide as on the common sliding rule. The diameter of the outer circle in this instrument is sixteen inches; and to obtain divisions of the same magnitude, a rule with its slide drawn must be eight feet four inches. The author considers that a circle of eight inches diameter would be sufficiently accurate for practical purposes, and would render the instrument extremely compact and portable.

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Mr. Mushet presented some specimens of malleable iron, in his opinion peculiarly adapted for railway purposes. The feature peculiar to this iron is, the omission of the refining process in its manufacture. The valuable properties of malleable iron being fibre and hardness, Mr. Mushet considers that these are but imperfectly secured by the present process. Iron, as at present generally manufactered, receives the fibre from repeated heatings and rollings; but fibre thus acquired, is obtained at the sacrifice of hardness. The fibre of malleable iron may be injured by overheating, by adding in the smelting furnaces ores rendering the iron cold, short; or by the use of cinders, which, when in excess, cause the fibre to crystallize and produce brittleness. Some irons, however, are so exceedingly fibrous, that they admit of a limited quantity of cinders without deterioration. By omitting the refining process, a greater mass of fibre can be produced than in any other manner; and this fibre, in consequence of the iron not being exposed to so severe a degree of decarbonization, is stiffer and harder than that acquired by repeated heatings and rollings. The iron used for railways should be from grey mine pig-iron, as the source from which the hardest and strongest fibre in malleable iron is derived. The use of cinder-pig should be excluded, on the ground that the quantity and quality of the fibre is injured; and if in the state of grey iron, its fusibility is so much increased, as to occasion great waste in the puddling and subsequent re-heatings.

"Paper on the Canal Lifts of the Grand Western Canal, by James Green."

These lifts are not intended to supersede the use of locks in all cases, but in those in which a considerable ascent is to be overcome in a short distance, and in which the water is inadequate to the consumption of a common lock, or in which the funds are inadequate to the execution of the work on a scale adapted to such locks. These lifts are forty-six feet in height, consisting of two chambers, with a pier of masonry between them, similar to those of a common lock, and being of sufficient dimensions to admit a wooden cradle in each, in which the boat about to ascend or descend floats. The cradle being on a level with the pond of the canal, a water-tight gate at the end of the cradle and of the pond of the canal is raised up and leaves the communication betwixt the water in the canal and the cradle fiee, and the boat swims in or out of the cradle. The cradles are balanced by very strong chains running over three cast-iron wheels, and are so arranged that the water in the upper cradle is about two inches below the level of the water in the pond, the consequence of which is, that the upper cradle has a slight preponderance, just sufficient to set the machinery in motion; the weight of this additional water being generally about one ton; it may, however, be regulated at pleasure. The principle of action is always maintaining the equilibrium between the cradles, is the well known one, that a floating body displaces a volume of fluid equal to its own weight. The cradles, when full of water, or when either or both of them contains a boat, will balance in any position; an additional weight of water in the descending cradle being necessary just to overcome the friction and the vis inertiæ of the machinery and cradles. It is obvious that the weight of the additional length of the suspending chains on the side of the cradle which is the lowest must be counterbalanced; this is effected by attaching to the under side of each cradle a chain of equal weight per foot with the suspending chains; and this, elongating under the ascending, and shortening under the descending cradle, removes the disparity in weight. The strength of materials is the great desideratum in machinery of this nature; and though the lifts here described are but forty-six feet, and the boats about eight tons, yet the same method is applicable to much greater heights and much heavier tonnage. The advantages of these lifts over common locks are great economy of construction and great saving of time and water, the time occupied in passing one boat up and another down this lift of forty-six feet being but three minutes, whereas in common locks to pass the same height would occupy thirty minutes. Also the quantity of water consumed is about two tons for eight tons of cargo, whereas in common locks it is about three tons of water per ton of cargo.

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From the London Repertory of Patent Inventions.

*Specification of the Patent granted to* John Macneill, *of Parliament Street, in the County of Middlesex, Civil Engineer, for Improvements in Making or Mending Turnpike or Common Roads.*—Sealed January 11, 1837.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said John Macneill, do hereby declare the nature of my said invention, and the manner in which the same is to be performed, are fully described and ascertained, in and by the following statement thereof (that is to say):—

My invention consists of an improved method of applying iron in the construction of roads, as will be hereafter fully described. I proceed, when making a new road, to obtain a suitable surface, and bring the same to a condition for laying on gravel or broken stones of various descriptions, suitable for making a strong hard surface for the passage of carriages and horses, as has heretofore been practised in making roads, but in place of completing the upper surface of the road with gravel or broken stone, or a combination of gravel and broken stone, as heretofore, I apply a quantity of pieces of wrought, or cast-iron mixed with broken stone, for the purpose of making a more hard and complete surface to roads, the pieces of iron may be of any shape that will bind in the road, but I prefer cubes of about one inch. The quantity of iron to be used with the broken stone or gravel will vary, depending on the degree of hardness and strength desired to be obtained to the surface of the road. Having laid the road with broken stone as heretofore practised, whether for a new road or an old one, I lay the pieces of iron in such a manner that they shall be from one inch to three inches from each other, depending on the strength required. By this means when by rolling the surface or by the ordinary traffic, the surface of the road has become consolidated, such surface will for the most part be composed of pieces of iron, which by oxydizing and otherwise, will bind fast with the other materials of the road, and produce a much harder and more solid surface than when broken stone or gravel alone is used. I would remark, that I am aware that attempts have been made to use iron in large blocks to pave roads in place of, and in like manner, to the blocks of granite commonly employed, though I believe without success. My invention does not, however, relate to paving of roads with blocks of iron, but only to the use of iron in dimensions assimilating to the broken stone or gravel with which it is combined.

Having thus described the nature of my invention, and the manner of carrying the same into effect, I would have it understood that what I claim, is the mode above described, of combining iron with ordinary road making materials for giving solidity and strength to roads as above described.—In witness whereof, &c.

Enrolled July 7, 1836.

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*Specification of the Patent granted to* HENRY HUNTLEY MOHUN, *of Walworth, in the County of Surrey, M. D. for Improvements in the Manufacturing of Fuel.*—Sealed October 4, 1836.

To all to whom these presents shall come. &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Henry Huntley Mohun, do hereby declare the nature of my said invention, and the manner in which the same is to be performed, are fully described and ascertained in and by the following statement thereof (that is to say):—

My invention consists in combining certain materials into fuel, as will be hereafter described, whereby I am enabled to produce a cheap and highly useful fuel. The materials employed by me are:—

First, Peat-earth, peat-turf, peat-moss, in slimy or other mud, or marl, or any any other earth which is composed largely of vegetable matter. Secondly, nitre. Thirdly, alum. Fourthly, linseed or other seeds, or shelled fruit. Fifthly, rosin. Sixthly, coke. Seventhly, any green vegetable matter; and, Eighthly, animal excrement, or other animal matter;

and in order to give the best information in my power for carrying out the invention, I will describe a process of combining these materials into a fuel.

*Description of the process of combining and pressing the Materials into Lumps of Fuel.*

Take one ton of peat in its raw or charred state; 30 lbs. of nitre, (the crude nitre does best); 14 lbs. of alum, which has the effect, when properly dissolved and thoroughly amalgamated with the rest, to prevent smoke; 14lbs of linseed; 14lbs. of resin, or asphaltum, or naptha; 150lbs. of coke; 168lbs. of green vegetable matter; 156lbs. of animal excrements, or other animal matter. Note. The quantity of the various materials will depend on the quality of the peat-earth, peat-turf, peat-moss, slimy or other mud, marl, or any other earth, which is composed largely of vegetable matter, and the above quantities are given for peat of the best quality, and in order to determine the relative quantities for any particular earth, it will be necessary to weigh out varying quantities, and having mixed, pressed, and dried them, to burn the same, in order to ascertain which mixture produces the description of fire desired; having thus tested the quantities required by any particular peat-earth, peat-turf, peat-moss, slimy mud, marl, or any other earth composed largely of vegetable matter, the process of mixing may be proceeded with for large quantities. The peat is first to be passed through the mixing mill, in a dry state, and the mill employed is an ordinary pug-mill, such as is used in brick-making; about one-third, or half, of the linseed is to be boiled in water, in order to produce a liquid about the consistency of thin glue: in this the alum is to be dissolved, the remainder of the linseed with the rosin and nitre, are to be crushed very fine, by edge stones or other means, and the green vegetable matter is also to be ground or crushed in like manner, and thus produce a pulp, taking care to keep the vegetable juices from running away. The whole of the materials are then to be mixed with spades, or otherwise, well ground in the pug-mill, the object being to obtain an intimate blending of the various materials, in order to the same burning equally. The combined mass thus so produced, is then to be pressed in moulds, by a strong screw, or other press, the shape and dimensions of the lumps not being material, but it is desirable the materials should be well pressed, in order to prevent the lumps readily coming to pieces; if well pressed, the fuel will be apt to crumble, and burn too fast if exposed to a strong draft; but I claim the combination, whether the same be submitted to pressure or not, the advantage of pressing being to increase the time it takes consuming. The lumps thus produced, are to be piled one on the other, leaving spaces between for the circulation of the atmosphere, and it will facilitate the preparation, to have such piles in a closed shed or room, the atmosphere of which can be heated, though in summer time, and in warm dry weather, this will not be necessary, unless great expedition is required; care must be taken not to expose it to a great artificial heat, when just formed or pressed. It must be dried by the atmosphere only, for the first two or three days. Note. The peat, it should be observed, may be first used for the purposes of distilling gas therefrom, as has been before practised, and the charred peat in the retorts, subsequently used for the making of the fuel, in place of the raw peat, as above described; and in order to make the new fuel, for the purpose of obtaining gas therefrom, for illuminating purposes, take in the proportion of 10 lbs. of nitre, 40 lbs. of rosin, 24 lbs. of linseed, 1 cwt. of green vegetable matter, 1 ton of peat, which being combined, and treated according to the directions above given, and the lumps put into ordinary gas retorts, and distilled similar to ordinary coal.

Having thus described the nature of my invention, and the manner of combining the same, I would remark that I do not confine myself to the precise three processes here described, for it will be evident that the object to be obtained, is a careful combining or mixing of the materials herein-mentioned, and the subsequent pressing the same into hard lumps, of convenient size; and whether such processes are conducted as above described, or by any other convenient means, it does not alter the nature of my invention; and I would remark that I do not claim the application of each of the eight parts or materials separately as a fuel, whether pressed or unpressed; some of them, such as the peat-earths, or peat-turf, peat-moss, and coke, and some others, have been used for fuel before; and note: the green vegetable matter is most useful as soon as possible after cutting, and when the vegetable juices are not dried up. Nor do I confine myself to the using the whole, or even the larger number of the eight matters above-mentioned into one fuel, though I believe the same to be the best compound; but what I claim is, the combining and pressing such materials into fuel, as above described.—In witness whereof, &c.

Enrolled April 3, 1837.

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*Specification of a Patent granted to* William Hancock, *of Windsor Place, City Road, in the County of Middlesex, Gentleman, for Certain Improvements in Book-Binding.*—Sealed December 7, 1836.

To all to whom these presents shall come, &c &c.—*Now know ye*, that in compliance with the said proviso, I, the said William Hancock, do hereby declare that the nature of my said improvements in book-binding, consists in attaching or binding the leaves of books together by applying caoutchouc, or solutions of caoutchouc, or caoutchouc partly in the sheet state and partly in a state of solution, in such manner to the backs of the said leaves, that sawing and sewing the same is rendered unnecessary, and books so bound are made to open perfectly flat, or more nearly so, than books bound by any other method heretofore in use; and also in applying caoutchouc in the said states, and in such manner to the backs of the sheets of books after they have been sewn or stitched in the usual way, as greatly to improve the same in point of solidity and elasticity. And the manner in which the same is performed, I shall now proceed to describe. Having folded the sheets of which the book is to consist, according to the determined size thereof, whether folio, quarto, octavo, or any other form, and assorted, made up, beat, and pressed, the same as is ordinarily done preparatory to sewing by the common method, I place them in a cutting-press between two cutting boards with just so much of the backs of the sheets projecting from the upper edges of the boards that, on cutting away the same, which I next proceed to do with the ploughing knife, the leaves of each sheet are separated and detached at the back from one another. The surface left by this ploughing process being commonly smooth, I make it a little rough either by rubbing it with sand paper, or by rasping it with a book-binder's grater or rake; sometimes also, I avoid altogether such smoothness of surface, by employing instead of the ordinary ploughing knife, a tooth plane with a very fine serrated edge. Immediately after cutting and before shifting the mass of leaves from the cutting-press, I apply to the back surface so cut and prepared, a coating of a solution of caoutchouc obtained by dissolving sheet caoutchouc in pure spirits of turpentine, in the proportions of a pound of the former to a gallon of the latter, or thereabouts. When the said coating is dry, I add a second coating of the same solution, and when that has also dried, I lay on a strip or band of caoutchouc cloth, which cloth I make by spreading a solution of caoutchouc obtained in the manner herein before mentioned upon linen, woollen, cotton, silk, or any other flexible material adapted to the purpose of book-binding. To cause this strip or band to adhere firmly to the back, I apply it in a warm sticky state, and then rub or press it on with the hand. The mass of leaves of which the book consists will now be found so firmly cemented together, that they may be removed from the cutting-press, and the boarding and finishing proceeded with in the ordinary way. Instead of ploughing away the whole of the backs of the sheets as aforesaid, two, three, or any greater number of broad grooves may be cut therein, at equal distances and just deep enough to go through all the folds that may be one within the other, and having coated the whole, the plain as well as grooved parts, twice over with a solution of caoutchouc as before directed, I insert in the said grooves cross bands of the caoutchouc cloth made as aforesaid, the ends of which cross bands I attach to the boards or covers of the books in the usual manner. Instead of employing a back band consisting of cloth or some other flexible material coated with a solution of caoutchouc; I sometimes find it convenient to make use of the sheet caoutchouc in its undissolved state, superadding thereto a coating of the solution. I find also that in the case of books in folio sheets, and of books in quarto when made up in half sheets, and of books in octavo when made up in quarter sheets, and generally of all leaves when in a simply duplicate state with a back of one fold, such sheets and leaves may be very securely cemented and bound together without any cutting or ploughing at the back, by applying caoutchouc in any of the states or modes aforesaid to the backs of such sheets or leaves, after the same have been assorted, made up, beat, and pressed, as aforesaid, for the purpose of binding. When a book is composed of leaves originally single, I plough and rasp them in the manner before described, and when such leaves are of large dimensions, such as plates or maps, I attach to the back edge of each by means of a solution of caoutchouc obtained as aforesaid, a strip of cotton or other suitable material of such size that it overlaps the leaf to the extent of about a quarter of an inch on each side, and then make up and bind together the sheets so individually prepared, in the manner hereinbefore directed for binding books of other descriptions. I find also that when books are sewn or stitched in the usual way, the solidity and elasticity of the backs thereof are greatly improved by applying thereto caoutchouc or solution of caoutchouc in the manner hereinbefore directed with respect to books consisting of quarter or other sheets with backs of only one fold.

And having now described the nature of my said invented improvements in book-binding, and the manner in which the same are to be performed, I declare that I do not claim as new, or of my invention, the employment of caoutchouc in book-binding, but that I claim as new and of my invention the employment of caoutchouc in book-binding in the manner and modes hereinbefore set forth, so that the sheets or leaves of books are in some cases bound together without sawing and sewing, and books so bound open perfectly flat or more nearly so than books bound by any other method heretofore in use. And in other cases where books are sewn or stitched in the usual way, the backs thereof are greatly improved in point of solidity and elasticity. And I claim as comprehended under my patent any and every other mode or manner of employing caoutchouc to produce the new and useful effects aforesaid, which shall involve no material departure from the manner hereinbefore specified. And such my invention being to the best of my knowledge and belief entirely new and never before used within that part of his said Majesty's United Kingdom of Great Britain and Ireland called England, his said dominion of Wales or Town of Berwick-upon-Tweed, I do hereby declare this to be my specification of the same, and that I do verily believe this my said specification doth comply in all respects with the proviso in the said hereinbefore in part recited letters patent contained; wherefore I do hereby claim to maintain exclusive right and privilege to my said invention.—In witness whereof, &c.

Enrolled June 7, 1837.

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*Simple Letter Copying Machine.* By N. S. Heineken.

The object of this contrivance is to afford to the traveller a portable instrument for copying letters, &c. It consists simply of a brass tube 14 inches long, and $1\frac{1}{4}$ diameter. One end, which has a bottom soldered into it and a cover fitted to it, contains a small bottle of copying ink. To the inside of the cover of the other end is attached a brush for the purpose of damping the paper. The space between is occupied by sheets of copying paper, together with some oiled paper and thick blotting, or filtering, paper in a cover. To use the instrument it is only necessary to place a sheet of copying paper between the leaves of blotting paper which have been previously wetted with the brush, and to let it remain till sufficiently damp—or, more expeditiously, to damp the copying paper itself with the brush and allow the dry paper to absorb the superfluous moisture. Place the paper thus prepared upon the letter, &c, and over it a piece of oiled paper and roll the whole tightly upon the outside of the brass tube which may be then rolled under the hands upon a table; a copy may thus be readily taken off. The tube also serves the purpose of a ruler.—*Lond. Mech. Mag.*

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## *Baltimore and Ohio Railroad.*

We are pleased to learn, as we do by the annexed notice, that the Baltimore and Ohio Railroad Company are about to resume active operations, and to extend their road to Cumberland.

*Engineer's Office, Baltimore and Ohio Railroad.*

Contractors for Graduation, Masonry and Bridging, throughout the country, are informed that in all the month of March 1839, the part of the Baltimore and Ohio Railroad between Harpers Ferry and Cumberland is expected to be finally located and ready for contract. The distance between those places is about one hundred miles upon the line of the Railroad, which will lie principally upon the Virginia Shore of the Potomac River.

The Graduation will require the removal of upwards of 3,000,000 cubic yards of material; the bridges will contain about 36,000 perches, and the Culverts and Walls about 107,000 perches of masonry; the aggregate length of the Bridge Superstructures will be about 2,500 feet. The roadbed will be graded for a double track throughout the line. A Tunnel of about 1000 feet in length will form part of the work. As it is intended to press the work forward with great activity, no proposal for any portion of it will be accepted from any person who is not able to give the most satisfactory security for his energetic prosecution of his contract and its faithful performance. The customary specifications and plans of all parts of the work will it is expected be ready at the Office of the Company in Baltimore, about the first of April, 1839. Of this more particular information will be given by timely advertisements. By order of the President and Directors.

BENJ. H. LATROBE,
Engineer of Location and Construction.

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From the Charleston Patriot.

## *To the Public.*

Perceiving from the public prints, that an apprehension seems to exist that I am about to relinquish the Presidency of the Louisville, Cincinnati and Charleston Railroad Company, for the purpose of becoming President of the Railroad Bank, I think it proper to state, that I am not a candidate for the latter office, and have no intention whatever of relinquishing the former. The flattering indications of an undiminished public confidence in my official conduct, and the apprehension expressed, that a change in the position I have occupied in relation to the Road, might operate unfavorably, upon the success of our great enterprize, would, if there were no other objections, be conclusive, in inducing me to retain my present position. I regard the success of the Road, as essential to the welfare of the country; and the Bank as the great instrument by which its success is to be secured. The same persons being the proprietors of both, and having a common interest in all their operations, the Bank and the Road should be conducted in perfect harmony, and each be made auxiliary to the success of the other. A contrary spirit must be fatal to both. For my own part, I cannot entertain a doubt that the affairs of the Bank may be so administered as to subserve the purposes of the Road, while at the same time a reasonable income may be secured to the Stockholders on the whole amount of their investments.

That these objects are attainable, cannot be doubted. The Athens Railroad and Banking Company of Georgia, both, I believe, under the Presidency of Mr. Dearing, have been able by a wise and liberal course of policy, to give full dividends, from the profits of the Bank alone, upon the whole capital invested both in the Bank and the Road, and this while two-thirds of the amount paid in, has actually been expended on the Road. The same results may be produced here. I still have undiminished confidence in the ultimate success of the great enterprize in which we are engaged. If sustained by the Stockholders, and supported by the country, we cannot fail. We have gone on so far successfully, and overcome difficulties far greater than any which are now before us. Perseverance is alone necessary to ensure success. ROBERT Y. HAYNE.

Charleston, 13th November, 1838.

*Baltimore and Susquehanna Railroad.*—At the invitation of the Board of Directors of this Railroad Company, a large number of the gentlemen connected with the municipal government of the city, with some others not so connected, made an excursion on the Railroad, on Saturday to the borough of York. The cars allotted for this excursion, left the outer depot, on Cathedral Street, at a quarter past eight, in the morning, and after several stoppages, as well to give the travellers opportunities of viewing particular parts of the route, as for other and stated purposes, the company arrived at the depot near York, at ten minutes after twelve; being thus four hours, less five minutes, on the way, including all stoppages. Arrived at the depot, the company left the cars, and proceeded on foot along the graduated way of the railroad through that borough to its point of termination east of North George Street, in the direction of the York County Alms House. Having thus made a reconnoissance of the whole line of the railroad, and marked the condition of the work and its style of execution, the company proceeded to the Globe Inn, where they found an abundant entertainment provided for them. After "the rage of hunger was repressed," some of the company sallied out to take a more extended view of the ancient town of York, while many of its good citizens repaired to the Globe Inn, and entered into friendly and social converse with those who remained.

A pleasant hour or two thus passed, and perhaps not unprofitable, as improving the social relations between "Baltimore and York." Shortly after three o'clock, P. M., the main body of the company repaired to the depot, and entering the cars "homeward bound," returned to the city in good season the same evening. A small number of the company remained in York until next day, being apparently too well pleased with the place, to be content with a visit of a couple of hours. These returned in the regular daily cars the following afternoon.

So far as we heard, the company were much pleased with their excursion on the railroad, and very generally and highly pleased with the substantial manner with which the work had been executed. With the exception of the portion in which the first rail was used at the commencement, it is believed to be one of the best and most substantial roads in the country.

Although laboring under the great inconvenience and disadvantage of being yet unfinished at each extremity, and thus occasioning difficulties, both to travel and transportation, which will cease, on the road being extended into the city, and to the permanent depot at York; the amount of the travel upon the railroad already, is understood to be quite encouraging. —*Baltimore Patriot.*

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*Railroad to Pittsburgh.*—The Harrisburgh Telegraph of the 30th ult. says: "We are pleased to learn by the Pittsburgh Times, that the Engineers employed to examine the route for a railroad from Chambersburgh to Pittsburgh, have reached the city, and report that a railroad can be made between the two points without an inclined plane. We hope the day is not far distant when a person can get into a railroad car at Philadelphia, and not get out until he gets to Pittsburgh or Erie, unless he choose. The Pittsburgh road will probably be made first."

We trust that the citizens of Philadelphia, who are deeply interested in this important work, will take immediate measures to bring it to the attention of the Legislature at the commencement of the session, in order that the road may be brought to completion as early as practicable. Our rivals cities, New-York and Baltimore, are adopting the most efficient measures to secure the great western trade. Shall Philadelphians quietly look on and see this great trade diverted from them? We hope not, but that our citizens will be up and doing.---*Amer. Sentinel.*

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*Beautiful Railroad Cars.*—The cars intended for night travelling between this city and Philadelphia, and which afford berths for twenty-four persons in each, have been placed on the road, and will be used for the first time to night. One of these cars has been brought to this city, and may be inspected by the public to-day. It is one of the complelest things of the kind we have ever seen, and is of beautiful construction. Night travelling on a railroad is, by the introduction of these cars, made as comfortable as that by day, and is relieved of all irksomeness. The enterprise which conceived and constructed the railroad between this city and Philadelphia, cannot be too highly extolled, and the anxiety evinced by the officers who now have its control, in watching over the comfort of the passengers, and the great expense incurred for that object, are worthy of praise, and deserve, and we are glad to find receive, the approbation of the public. A ride to Philadelphia now, even in the depth of winter, may be made without inconvenience, discomfort, or suffering from the weather—you can get into the cars at the depot in Pratt-street, where is a pleasant fire, and in six hours you are landed at the depot in Philadelphia! If you travel in the night you go to rest in a pleasant berth, sleep as soundly as in your own bed at home, and on awakening next morning find yourself at the end of your journey, and in time to take your passage to New-York if you are bent there! Nothing now seems to be wanting to make railroad travelling perfect and complete in every convenience, except the introduction of dining cars, and these we are sure will soon be introduced.—*Baltimore Chronicle, Oct.* 30.

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*New Haven and Hartford Rail Road.*—Some eight to ten miles of our Rail Road to Hartford being completed, and the Locomotive and Cars being in readiness, the Agent and Directors, with a small party of gentleman, made a short excursion this morning to try the quality of the materials and test the susceptibility of motion. At ten o'clock, two cars, with the locomotive, started and proceeded as far as the bridge in North Haven, a distance of about seven miles. This was performed, on the upward stretch, in 25 minutes, and in the downward in 19, without any effort at extra speed. Every thing worked kindly and happily, showing that the parts of the machinery were properly adapted to the purposes for which they were designed. The rail track is remarkably smooth and easy, the cars elegant and commodious, and there was none of that jerking and jarring motion in starting and stopping that we have observed on other roads. We understand that nearly all the iron has been received to complete the road to Meriden, one vessel being due that has the balance on board. When this is received, a few days will suffice to complete the track, and we shall then look to our Hartford friends to meet us half way. We understand the good word is going on prosperously with them, and we are well assured that their accustomed energy will not leave them in the rear.—*New Haven Herald.*

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*Cumberland Valley Railroad.*—Business is rapidly increasing on this Road, and wagons we understand, are wanted to haul goods from the Depot in this place to Pittsburgh and Wheeling.-*Chambersburg Repository.*

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 11, Vol. I. New Series. ] DECEMBER 1, 1838. [ Whole No. 323. Vol. VII.

*Hudson and Berkshire Railroad.*

THIS Railroad has been in successful operation since the middle of September last. Two trains pass daily, each way, a distance of thirty-three miles; and the number of passengers and amount of freight thus far, we are informed, much exceed the original estimates.

The grades, in going east from Hudson, are mainly ascending, for near 25 miles; about three miles of which have 70, and a quarter of a mile 80 feet ascent to the mile; yet, with Engines of Norris's manufacture, two of which are on the road, loads of from 60 to 75 tons are taken over these grades without any difficulty; and the apprehensions which were entertained by many of the successful application of locomotive power to these grades, are entirely dispelled.

The ancient city of Hudson is entitled to much credit for its persevering enterprise in completing this work during the late period of embarrassment; and it will most assuredly reap a rich reward, as well from the increased amount of travel as from the facilities for bringing to market the products of the soil, and of the rich quarries of marble and beds of iron.

We should have noticed this work at an earlier period, but were in hopes to have received a full description of its construction, cost, business, &c. &c.; but in the multiplicity of engagements attendant upon the opening and conducting of such a work, the Engineer has omitted to furnish it for publication in the Journal—an omission which we the more readily overlook, as it is presumed the delay will enable him to make it the more complete and satisfactory. It shall be published as soon as received.

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*To Correspondents.*—The letter of J. C——r was duly received, and the correctness of his suggestions are fully admitted; and we assure him that the two valuable machines spoken of by him—and others of admitted value—shall be properly noticed, if he will furnish us with proper descriptions of them.

If we do not as often refer to "new inventions and machines," "as to Railroads," it is because Mechanics are not as prompt in furnishing us with the facts and descriptions, as those interested in internal improvements.

We are very desirous to make the "Journal and Magazine" the medium of communication between inventors and the public, but can only do so when furnished with the means.

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[We are much indebted to Mr. Roebling for the following communication—and solicit a continuation of such articles as have been furnished by him and other gentlemen.]

For the Railroad Journal and Mechanics' Magazine.

*An Essay on the Obstruction of Streams by Dams; with Formulæ for ascertaining the rise of water caused by their construction.* *By* S. A. Roebling, *Civil Engineer.*

When a stream is to be obstructed by a dam, for the purpose of creating a water power, making a slack-water navigation, or feeding a canal, it is a matter of importance to know how high the water will rise above its former level in time of freshets.

Owing to the want of proper investigation, notions contradictory to common sense, have been entertained by professional men on this subject, and the consequence has been, that their works have not realized their expectations. With a view of throwing some light upon this very important subject, the following illustrations and deductions, based upon the theory of *Du Buat* and *Eytelwein*, are offered to the public.

To compute formulæ for the rise of water by dams, it is necessary to know the amount of water discharged by a freshet, the average width of the stream, its average depth and area of cross section.

But the gauging of a large stream in high water is a difficult matter, and at the period when the construction of a dam is to be commenced, there is generally no time to wait for a freshet, for the purpose of making the desired measurements. I would therefore propose, for ascertaining the greatest discharge of water, to gauge the river when at its medium height. For this purpose, let a cross section of the stream be taken, and the velocities of the surface measured at each sounding. It has been ascertained by experiments, that the velocity of water, in streams, *decreases* towards the bottom for every foot depth:

$$0{,}008\, v$$

where $v$ signifies the velocity at the surface. If we now put the depth, for which the average velocity is to be ascertained, equal to $h$, and denote the required average velocity by $v'$, the we have the velocity at the bottom equal to

$$v - 0{,}008\, v\, h$$

From the surface velocity and bottom velocity we find the average velocity,

$$v' = \frac{v + v - 0{,}008\ v.\ h}{2} = v - 0{,}004\ v.\ h$$

$$\text{or,} \qquad v' = v\,(1 - 0{,}004\ h)$$

When the average velocity, for each sounding, has been thus calculated, we can find the discharge per second, in cubic feet.

For ascertaining the discharge of a river, in time of a high freshet, let its width equal to $l$. By dividing $l$ into the area of the cross section which has been measured, we get the average depth of the water, which may be represented by $h$. The area of the profile, divided into the discharge, gives us the average velocity of the whole section, which may be represented by $v$. The average velocity of a stream in different stages of the water, are, according to Buat and Eytelwein, as the square root of the different average depths.

Now, let us represent the average velocity of a cross section of a high flood by $v'$ and the average depth of that section by $h'$

$$\text{Then is} \qquad v : v' :: \sqrt{h} : \sqrt{h'}$$

$$\text{therefore,} \qquad v' = v\frac{\sqrt{h'}}{\sqrt{h}} = v\sqrt{\frac{h'}{h}}$$

The average velocity of a high freshet, thus found, multiplied into the area of its cross section, gives us the required discharge.

The above method should be applied, if the necessary measurements can be taken, when the stream is at or near its medium height. Without those data, however, an approximate result can be obtained by the formula:

$$v = 90{\cdot}9\sqrt{\left(\frac{a}{p} \times \frac{h}{l}\right)}$$

where $v$ is the average velocity in feet per second, $a$ the area of the profile in superficial feet, $h$ the fall of the river for a certain length $l$ in feet; $p$ signifies the perimeter of the profile, not including the line of surface.

The product of the area into the velocity, thus found, will give the required discharge. This formula, however, cannot be relied on when the stream is irregular; it applies with accuracy only to smooth and regular channels and to canals.

The velocities with which water is discharged through a horizontal opening in the side of a vessel, are according to the laws of gravity, in proportion to the square roots of the respective heights of the columns of water above the orifices. The pressure, which the particles of water support at a certain depth, is proportionate to the velocity with which they tend to escape. This velocity is hypothetically equal to that, acquired by bodies falling through the same space. The velocity of a body, acquired at the end of the first second of its fall is $= 2 \times 16{\cdot}1 = 32{\cdot}2$ feet, and if we denote the different velocities by $v$ and V, and the respective heights by $h$ and H, then according to the laws of gravity

$$\text{is} \qquad v : V :: \sqrt{h} : \sqrt{H}$$

$$\text{and} \qquad V = \sqrt{\frac{v^2\,H}{h}}$$

If we take $v = 32{\cdot}2$, and $h = 16{\cdot}1$, we have:

I. $V = \sqrt{\frac{32.2^2 \, H}{16.1}} = 8.024 \, \sqrt{H}$ and

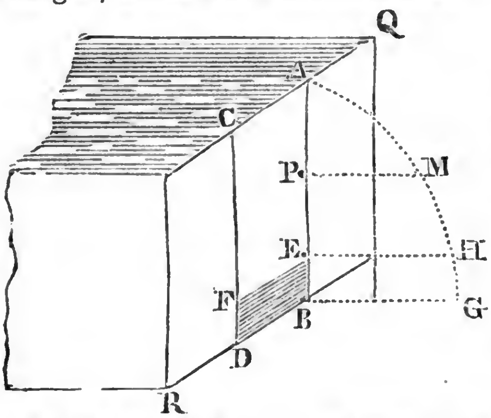
II. $H = \frac{v^2}{8.024^2} = 0.0155 \, V^2$

The quantity 8,024 is called the hypothetical co-efficient for falling bodies, and this co-efficient will be here generally denoted by the letter $\alpha$. In applying the above rule to the motion of water, the case is somewhat different under different circumstances. Du Buat and Eytelwein have made a number of satisfactory experiments to fix co-efficients for the velocity of water in different circumstances.

According to these experiments, for instance, the value of the co-efficient for the discharge of water over a waste-weir, of common construction, is found to be - - - - - - - = 5·7

For large and well constructed dams, where all circumstances are favorable to the discharge, - - = 7·5

Before we can proceed to demonstrate the discharge of water over dams, we have to examine the laws under which water generally will be discharged, when under acertain head.




The annexed diagram represents a vessel, Q R, filled with water up to A. Suppose that sufficient water is flowing in to keep the surface at the same level, and that there are several small openings, P, E, B, above each other in the vertical line A B, in one side of the vessel.

The jets of water streaming through the opening P, E, B, are represented by the horizontal dotted lines, P M, E H, B G.

Let us put A P $= x$; the velocity with which the water rushes through the opening P, be $= y$; and the co-efficient of this velocity be $= \alpha$.

So is, by formula I,

$$y = \alpha \sqrt{x}.$$

The same is applicable to every other opening B, with a head of pressure = A B; and if we denote A B by $h$, and the corresponding velocity by $v$, we have

$$v = \alpha \sqrt{h}$$

Now let $PM = \alpha \sqrt{x} = y$

and $BG = \alpha \sqrt{h} = v$

Then is $AP : AB :: x : h$

and $PM : BG :: \sqrt{x} : \sqrt{h}$

or $PM^2 : BG^2 :: x : h$

Therefore $AP : AB :: PM^2 : BG^2$

The same is true for every other absciss and ordinate, as A P, and P M, and from this it follows, that the curved line A M H G, which is formed by the extreme points M, G, &c. of the dotted lines, representing the velocities of the water-jets, forms a *Parabola*. If we now imagine the vertical line A B consists of a great number of such small openings, than the amount of water, or the sum of all the water-jets, may be represented by the area of the parabola. The superficial content of the parabola A B G is

$$= \tfrac{2}{3}\, A B .\, B G = \tfrac{2}{3}\, v\, h$$

If we denote the width of the perpendicular narrow opening or slit A B, by $l'$, the amount of water discharged through this slit will be

$$= \tfrac{2}{3}\, l'.\, v.\, h$$

Now, suppose the great rectangular opening, A B C D, consists of a large uumber of such vertical openings, and let be

$$A C = B D = l$$

and the discharge through that rectangle = Q, then we have

$$Q = \tfrac{2}{3}\, l\, v\, h$$

and by substituting for $v$, its value = $\alpha \sqrt{h}$, we have the discharge per second, or

III. $$Q = \tfrac{2}{3}\, \alpha\, l\, h \sqrt{h}$$

and $$h \sqrt{h} = \frac{Q}{\tfrac{2}{3} \alpha\, l} \text{ or } h^3 = \left(\frac{Q}{\tfrac{2}{3} \alpha\, l}\right)^2$$ or

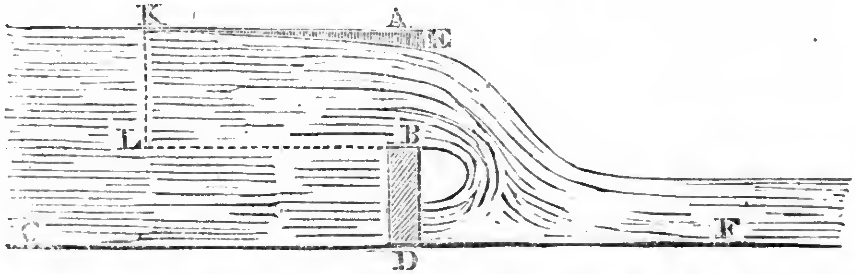
IV $$h = \left(\frac{3\, Q}{2\, \alpha\, l}\right)^{\frac{2}{3}}$$

In investigating the state of water, when obstructed by dams, three different cases present themselves.

1.

When a dam serves only as a waste-weir, and the pool above it forms an extensive sheet of water, the surface of which is kept at the same level, without any perceptible current.

In the annexed diagram, B D represents the dam or weir; the line K A, the level of the upper pool; and C F, the bed of the river or reservoir, corresponding to the average depth of the water.




The body of water, discharging over a dam, will sink considerably below the level of the surface of the pool, before it reaches the breast of the dam, forming a curve tangential to the surface of the pool.

The formulæ III and IV apply to this case exactly. The height $h$, or the head of the fall, is in the diagram represented by the lines K L = A B, the elevation of the surface above the top of the dam.

If we, therefore, know the quantity of discharge per second, we find by the formula IV the height corresponding to it; and if the height is known, we find the discharge by formula III.

The height of the water above the edge of the dam, or B E, and the contraction of it below, is here not taken in consideration, as it is of no practical use.

2

When, as in the first case, the comb, or top of the dam is above the surface of the lower pool, and the water in the upper pool arrives at the head of the fall with a certain velocity.

With reference to the above diagram, let us term the point K in the surface of the upper pool, where the water is horizontal, or nearly so, or has yet about the same inclination as the pool farther up, the *head of the fall.*

The elevation of this point B above the top of the dam, or A B,
may be denoted by the letter - - - - - - - $h$
The height of the dam, or B D, by - - - - - - K
The average width of the pool, by - - - - - - B
The length of the dam, by - - - - - - - - - $l$
The quantity of discharge over the dam per second, in cub. feet, by Q

The line C F represents the bed of the river, (corresponding to the average depth) as well as the base of the dam, and all the heights are calculated from it.

If we now suppose the upper pool forms a still water without any current, then we have the former case, and if we represent the fall, or A B, by the letter $h'$, we find according to formula IV

$$h' = \left\{ \frac{3\,Q}{2\,\alpha\,l} \right\}^{\frac{2}{3}}$$

But in the present case the water arrives at the head of the pool, with a certain velocity due to the current in the river above the pool, and this velocity comes to the aid of the velocity of discharge, caused by the height of the fall.

The velocity of the discharge is therefore equal to the velocity, due to the height of the fall. plus the velocity, due to the current of the pool. But the quantity of discharge remaining the same, and the velocity being increased, the height of a discharging body of water will be reduced in a proportion corresponding to the increased velocity. The water in the pool, is in consequence of the current in motion through its whole depth, though the velocity near the bottom is but very small.

We find the area of the cross section equal to

$$(h+K)\,B$$

and if $v$ represents the average velocity of the current in the pool, we have

$$v = \frac{Q}{(h+k)\,B}$$

Now, let us represent the height which corresponds to this velocity, by the letter H, then we have, according to formula I,

$$H = 0\,0155\,v^2$$

and by substituting for $v$ its value, we get

$$H = 0{\cdot}0155 \left\{ \frac{Q}{(h+k)\,B} \right\}^2$$

For finding the true height of the surface of the pool above the top of the dam, or the height A B $= h$, we have therefore to deduct the value of H from the value of $h'$, and we arrive at the formula

$$\text{V}' \quad A\,B = h = \left\{ \frac{3\,Q}{2\,\alpha\,l} \right\}^{\frac{2}{3}} - 0{\cdot}0155 \left\{ \frac{Q}{(h+k)\,B} \right\}^2$$

And if we put the co-efficient $\alpha = 7{\cdot}5$ and $B = l$, we have

$$\text{V} \qquad h = \left\{ \frac{3\,Q}{15\,l} \right\}^{\frac{2}{3}} - 0{\cdot}0155 \left\{ \frac{Q}{(h+k)\,l} \right\}^2$$

This formula contains in the subtractive member the value of $h$ itself. As this term of the equation, however, is comparatively small, it will be sufficiently correct in practice, to find the value of $h$ by approximation, without making the formula more intricate by further reduction.

EXAMPLE 1.

Suppose a dam of 500 feet long and 11 feet high, has been constructed across a river of the same width, the average depth of which in time of a high freshet is 10 feet, and its discharge at the same time 25,000 cubic feet, per second. How much will the water rise above the top of the dam, if all circumstances are favorable to the discharge, and the co-efficient $\alpha$ is put $= 7{\cdot}5$?

The above formula for $h$, is here

$$h = \left\{ \frac{3\;25000}{15\;500} \right\}^{\frac{2}{3}} - 0{\cdot}0155 \left\{ \frac{25000}{(h+11)\cdot 500} \right\}^2$$

Now, let us assume $h = 4{,}5$

$$\text{then is} \quad h = \sqrt[3]{100} - 0{,}0155 \left\{ \frac{25000}{15{,}5\,.500} \right\}^2$$

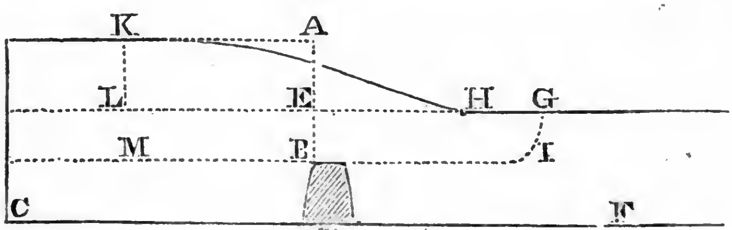
$$\text{or,} \qquad h = 4{,}641 - 0{,}161$$

$$\text{therefore,} \qquad h = 4{,}48 \text{ feet.}$$

This result is near enough to the assumed value, and therefore sufficiently correct.

3.

When the top of the dam is lower than the surface of the lower pool, and the water in the upper pool arrives at the head of the fall with a certain velocity.




The annexed diagram may respresent the case in question, and we will represent the depth of the river below the dam, or E D, by the letter - - - - - - - - - $h$

The height of the fall from the upper level to the lower level, or A E by - - - - - - - - - - - H

The height of the dam, or B D, by - - - - - - K

The length of the dam, or width of the river, by - - - - $l$

The quantity of water discharged per second, by - - - Q

The line C F may represent the bed of the river corresponding to the average height $h$ of the water.

To simplify the demonstration of this case, let us suppose the water in the upper pool form a perfect level without current, and not consider the effect which the whirl below the dam, caused by the fall of the water, has upon the discharge.

The quantity of water discharged through the height A E, will then be found by formula III.

$$= \frac{2}{3} \alpha\, l\, H \sqrt{H}$$

The body of this water above the level L E presses upon the body of water below, included between the dotted lines L E and M B, which, therefore, will be forced to pass off through the height E B.

Let us now imagine a pipe E H G I B, of the width of the river, and the height E B resting on top of the dam, with one vertical opening E B at the dam, and another horizontal opening H G at the surface of the lower level, below the fall. The body of water included between the lines L E and M B, would then pass through this pipe, and be discharged at the surface of the lower level with a velocity corresponding to the pressure of the water above, or due to the height A E. The velocity of the water flowing through the height E B is therefore found, according to formula I

$$= \alpha \sqrt{H}$$

and the discharge

$$= \text{E B}.\, l.\, \alpha \sqrt{H} = \alpha\, l\, (h - k) \sqrt{H}$$

The kischarge through the height A B is equal to the sum of discharges through A E and E B, and therefore

$$Q = \frac{2}{3} \alpha\, l\, H \sqrt{H} + \alpha\, l\, (h - k) \sqrt{H} \qquad \text{or}$$

$$\text{VI} \qquad Q = \alpha\, l \left(\tfrac{2}{3} H + h - k\right) \sqrt{H}$$

and from this we find

$$\text{VII} \qquad H = \frac{Q}{\alpha^2\, l^2 \left(\frac{2}{3} H + h - K\right)^2}$$

The value of H must be found here by approximation, as in formula V.

With respect to the velocity of the current in the upper pool, Mr. Eytelwein offers a formula for the value of H, the application of which is very difficult on account of its perplexity. The following demonstration, however, will bring us near enough to truth, and furnish a formula which will be found sufficient to all practical purposes.

When H has been found by formula VII, we have then an approximate value for the average depth of the upper pool, or

$$\text{A D} = H + h$$

The area of the profile of the upper pool is therefore

$$= l\,(H + h)$$

From this we find the average velocity of the current in the pool

$$= \frac{Q}{l\,(H + h)}$$

which velocity is owing to the current of the river above, independent of the fall of the water over the dam.

According to formula II, we find the height, corresponding to this velocity

$$= 0{\cdot}0155 \left\{ \frac{Q}{l\,(H + h)} \right\}$$

which ought to be deducted from the value H in formula VII, as we have done in case No. 2, in order to arrive at the true height of the fall.

We therefore arrive at the formula

$$\text{VIII} \qquad H = A E = \frac{Q^2}{\alpha^2 l^2 (\frac{2}{3}H + h - K)^2} - 0{\cdot}0155 \left\{ \frac{Q}{l(H+h)} \right\}^2$$

The objection can be made against this formula, that the current of the upper pool may be reduced by the resistance of the water below, and that then the value of H is found too small.

To examine this question, we must distinguish several cases. The first case is, when a dam forms a breast-dam, with no lower slope. The falling water will here produce a whirl, the effect of which will not extend far below the dam, and will have little influence on the current of the tail-water. The second case, when the dam has a long slope forming an inclined plane, or better, an inverted parabola, on which the water glides down. The lower body of water, after having moved down the slope, shoots off in a more horizontal direction, not affecting the bed of the river immediately below the dam, but pushing ahead the tail-water, the current of which consequently will be increased. Without reference to the form of dams, other considerations present themselves with respect to the depth of the water. When the river is not deep, and the lower level but little above the top of the dam, the escape of the tail-water will be increased by the mechanical momentum, produced by the *height of the fall* of the water, rolling down the slope, and the resistance offered to the current of the upper level, will be therefore decreased. On the other hand, when the dam is very low and the water very high, the momentum of the falling water will be increased proportionably by the *general increase of the velocity* of the river, and will therefore also increase the velocity of the tail-water below the fall, so as not to resist the current above.

It appears, therefore, that we may apply the above formula, without any deduction, in all cases *favorable* to the escape of the tail-water. When the construction of the dam, and the features of the river, however, are *unfavorable* to the discharge of the tail-water, then we must reduce the value of the subtractive member of the formula.

The value of the co-efficient $\alpha$ should be fixed with reference to the construction of the dam, and to the nature of the pool above the dam.

When a dam serves as a waste-weir, and the pool above the dam, forms proportionally an extensive sheet of water with no current, then the value of $\alpha$ is found, according to Du Buat and Eytelwein, to be = 5·70

For a dam in a small stream, with no wing-walls and embankments confining the current, we may put $\alpha$ . . = 7·00

For a dam in a large river, with wing-walls and high embankments, leading the current fairly to the fall, we may put $\alpha$ . . . . . . . . . . . = 7·50

### Example 2.

A river is 500 feet wide, its average depth in time of a freshet is 10 feet, and its discharge at the same time 25000 cubic feet per second. A dam of 500 feet long, and 7 feet high, has been constructed across the river. How much will the water be raised above its former level, or how much is the height of the fall from the upper level to the lower level?

The co-efficient $\alpha$ be here = 7·5.

By applying the formula VIII, and substituting the above data, we have

$$H = \frac{25000^2}{7{,}5^2 . 500^2 (\frac{2}{3}H + 10 - 7)^2} - 0{,}0155 \left\{ \frac{25000}{(H+10) . 500} \right\}^2$$

effect which the whirl below the dam, caused by the fall of the water, has upon the discharge.

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We therefore arrive at the formula

VIII $$H = AE = \frac{Q^2}{\varkappa^2 l^2 (\frac{2}{3}H + h - K)^2} - 0{\cdot}0155 \left\{ \frac{Q}{l(H+h)} \right\}^2$$

The objection can be made against this formula, that the current of the upper pool may be reduced by the resistance of the water below; and that then the value of H is found too small.

To examine this question, we must distinguish several cases. The first case is, when a dam forms a breast-dam, with no lower slope. The falling water will here produce a whirl, the effect of which will not extend far below the dam, and will have little influence on the current of the tail-water. The second case, when the dam has a long slope forming an inclined plane, or better, an inverted parabola, on which the water glides down. The lower body of water, after having moved down the slope, shoots off in a more horizontal direction, not affecting the bed of the river immediately below the dam, but pushing ahead the tail-water, the current of which consequently will be increased. Without reference to the form of dams, other considerations present themselves with respect to the depth of the water. When the river is not deep, and the lower level but little above the top of the dam, the escape of the tail-water will be increased by the mechanical momentum produced by the *height of the fall* of the water, rolling down the slope, and the resistance offered to the current of the upper level, will be therefore decreased. On the other hand, when the dam is very low and the water very high the momentum of the falling water will be increased proportionably by the *general increase of the velocity* of the river, and will therefore also increase the velocity of the tail-water below the fall; so as not to resist the current above.

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Let us assume H = 2,00; then we get

$$H = \frac{44,44}{(\frac{2}{3}.2+3)^2} - 0,0155 \left\{ \frac{25000}{12.500} \right\}^2$$

$$\text{or} \quad H = \frac{44,44}{18,775} - 0,0155 . 17,361$$

$$\text{or} \quad H = 2,367 - 0,269 = 2,098 \text{ feet.}$$

which result is near enough to the assumed value of H, and therefore sufficiently correct.

EXAMPLE 3.

A dam of 800 feet long, and 6 feet high, is to be constructed across a river of about the same width, and which in time of a high freshet discharges 60,000 cubic feet per second, and has an average depth of 16 feet. What will be the height of the fall, or the value of H, if we put $\alpha = 7{\cdot}5$?

Let us assume the value of H = 0,8, then we have

$$H = \frac{6000^2}{7,5^2.800^2\ (\frac{2}{3}.0,8+16-6)^2} - 0,0155 \left\{ \frac{60000}{16,8.800} \right\}^2$$

$$\text{or} \quad H = \frac{100}{(0,533+10)^2} - 0,0155 \left\{ \frac{60000}{13440} \right\}^2$$

$$\text{or} \quad H = \frac{100}{110,944} - 0,0155 . 19,927$$

$$\text{or} \quad H = 0,901 - 0,3088 = 0,593 \text{ feet.}$$

This result does not agree with the value assumed for H, and is too small. From the nature of the formula it follows, that we must assume a smaller quantity for H. Let us therefore put H = 0,6, and we have

$$H = \frac{60000^2}{7,5^2.800^2(\frac{2}{3}.0,6+10)^2} - 0,0155 \left\{ \frac{60000}{16,6.800} \right\}^2$$

$$\text{or } H = \frac{100}{(\frac{2}{3}.0,6+10)^2} - 0,0155 \left\{ \frac{60000}{13280} \right\}^2$$

$$\text{or } H = \frac{100}{108,16} - 0,0155 . 4,158^2$$

$$\text{or } H = 0,924 - 0,316 = 0,608 \text{ feet.}$$

This result agrees well with the assumed value of H, and is therefore sufficiently correct.

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## *Remarks on De Pambour's Formula, in reply to Mr. E. F. Johnson.*

MESSRS. EDITORS—I notice, with some surprise, in the 8th number of your Journal, an attempt by Mr. E. F. Johnson to evade the charge of having attributed in his letter of April 7th, the errors in the table of the power of Locomotive Engines, submitted by him to the Directors of the New-York and Erie Railroad Company, to an alleged inaccuracy in De Pambour's formula, and an insinuation that I have asserted that charge in my communication of June 15, without any just grounds. This attempt is as futile as the insinuation is false; for the whole object and tenor of Mr. Johnson's letter was, to excuse the errors in his table, on the ground that the cause of them lay in the formula, and that "owing to the haste" in which he prepared that table, he did not notice at the time the full extent of the defects in De Pambour's formula. This is distinctly expressed in the following extract from Mr. Johnson's letter of April 7. "As to the accuracy of De Pambour's formula within the limits in which it may be considered properly applicable, although I believed it to be nearer the truth than appears on a more critical examination, yet I gave it as my opinion that it was imperfect." And one of those imperfections consists, according to Mr. Johnson, in the fact that the formula in question "does not designate the point at which it ceases to be applicable." We should be glad to have Mr. Johnson show us how that formula could have been arranged, so as to designate its own proper limits. The very nature of the formula makes this impossible, and it must always be left to the judgment of those who employ such formulæ, to know their proper limits. There are many important formulæ in science that contain no term which designates the point at which they cease to be applicable, and are nevertheless perfectly correct.

As to the fact, which Mr. Johnson states, that De Pambour in his practical table, (page 186, Philadelphia edition—page 216, London edit.) has been, in at least one instance, led into precisely the same error with himself and Mr. Talcott, (*i. e.*, has applied his own formula beyond its proper limits, and thus obtained a result where the resistance on the piston is greater than the force that is to move it,) we simply state that *this fact does not exist*, and that the error in De Pambour's table, which Mr. Johnson as well as Mr. Talcott adduce as a precedent, or sort of palliative, for their own errors, arises from an entirely different source, and is in fact nothing more than an accidental omission to subtract the last term of an equation, as we have already shown in our communication of October 9th, in reply to Mr. Talcott. It is evident that De Pambour constructed that table, by first determining the maximum loads of Engines under different pressures, according to the formula

$$M = \frac{(P - p)\, d^2 l}{\varepsilon + n} - \frac{F}{\varepsilon + n}$$

with their corresponding velocities, and did not make use of the formula

$$V = \frac{m P S D}{(F + 9 M) D + p d^2 l} \quad \text{or,} \quad M = \frac{m P S D - p d^2 l V}{9 V D} - \frac{F}{9}$$

which Mr. Johnson employed in the construction of his table, except to determine the intermediate loads and velocities after having fixed the limit of the Engines under given pressures; and the instance where the error occurs is in the computation of the maximum load of an engine.

We never charged Mr. Johnson with any intention of disparaging the labors of De Pambour; we only said that until Mr. Johnson demonstrated to us the alleged defects in De Pambour's "mode of conducting and analyzing his experiments," we should view his formula correct; and if Mr. Johnson will take the trouble to re-peruse our remarks of June 15, he will find that we have done him no injustice, as he conceives, unless, indeed, the pointing out and correcting his errors constitute the injustice, in which case we must plead guilty, and even be unjust enough to repeat the offence.

Mr. Johnson, determined to support the assertion that De Pambour's "mode of conducting and analyzing his experiments" was deficient, favors us with a "critical examination" of some of these defects, and endeavours first to show that De Pambour has not made the proper corrections in the use of the spring-balance, because he takes into account only, 1st. the pressure produced by the weight of the lever at the place of the valve; 2d, the pressure produced at the end of the lever by the weight of the rod, the screw and spring; 3d, the weight of the disk of the valve. Mr. Johnson then, by quite an inexplicable process of reasoning, establishes that the weight of the plate, tube, and foot of the balance at the end of the lever, must be added to the above parts; in a word, he tells us that *the whole weight of the balance* at the end of the lever should be added to the amount pointed out by the index. Now, on all the Engines we have ever seen, the safety-valve was so arranged, that the foot of the balance with its plate and tube, was firmly attached to and supported by the boiler; and therefore, only those parts, which De Pambour was the first to notice in the corrections to be made to the weight marked by the spring-balance, are all that should be taken into account, notwithstanding Mr. Johnson's incomprehensible demonstration to the contrary.

Mr. Johnson next suggested another correction not noticed by De Pambour, to made in the use of the spring balance resulting from the miter of the valve, by which a greater surface is exposed to the atmospheric pressure than that upon which the steam presses. This error can only exist when the valve is perfectly close to its seat, and then it can never be exactly ascertained, as in that case the spring balance only indicates the pressure of the steam in a *negative* manner; for so long as the valve is perfectly closed, all that we know is, that the steam is of less force than the pressure of the spring balance added to that of the atmosphere. But the instant the valve is raised off its seat, in ever so slight a degree, we then know the pressure of the steam *positively;* but then also the error, which Mr. Johnson points out, ceases to exist; for then the air (owing to its nature as a fluid,) and the issuing steam meet upon the same place of the valve. As in most Locomotive Engines the miter is only $\frac{1}{4}$ of an inch, the extreme error resulting thence, can at most be 3lbs.; for taking a valve of $2\frac{1}{2}$ inches diameter with $\frac{1}{4}$ inch miter, making the upper diameter $2\frac{3}{4}$ inches, we have $\frac{(5{\cdot}930 - 4{\cdot}908) \times 14{\cdot}7}{4{\cdot}908} = 3{\cdot}08$, which is but 4 per cent. upon the pressure at which Locomotive Engines are generally worked, instead of 14 per cent as Mr. Johnson states. This error, however, could in no degree have affected the results of De Pambour's experiments, as in all cases, he invariably verified the pressure indicated by the spring balance, by the mercurial gauge. But Mr. Johnson rejects the use of that instrument in toto, because De Pambour says, that "the steam having to pass through a long and narrow tube arrives on the mercury at a less degree of pressure than in the boiler." Now, De Pambour is very far from disparaging the value of the mercurial gauge, for he says, (page 56, London edition)—"We may therefore easily conceive the great utility of an instrument which at first sight, and by its mere inspection, will give *the exact measure* of the pressure of the steam.

The remarks quoted by Mr. Johnson, and upon which alone he bases his objections to the steam gauge, was thrown out by De Pambour, merely as a suggestion of the great care which is necessary in its use, and the inconvenience attending upon its application to Locomotive Engines. Mr. Johnson forgets entirely that the communication between the boiler and the mercury being uninterrupted, the steam of necessity continues to flow upon the mercury until a perfect equilibrium is established, and the pressure upon the mercury becomes precisely the same as in the boiler.

From these imaginary defects in the spring balance and mercurial gauge, Mr. Johnson concludes that both these instruments should be rejected, as also the proposed portable manometer by De Pambour, and then suggests a new mode of his own for ascertaining the pressure of the Steam in the boiler, which however bears impracticability upon its very face. He "conceives" that the spring balance applied to a cylindrical pston, will have the "peculiar advantage" of giving "the actual pressure without any correction." Every practical man, will see at a glance, that such an instrument would be utterly inapplicable; for the proposed cylindrical piston must be steam tight, and how are we to estimate accurately the friction produced by the piston against the sides of the cylinder?

Mr. Johnson next proceeds to notice what he conceives to be "evidently a defect in the formula of De Pambour," namely, that he assumes the evaporating power of Locomotive Engines as a constant quantity, whereas it varies with the velocity, because of the greater number of cylinders full of steam ejected through the chimney, by which the draught, and consequently the combustion of the fuel is increased. De Pambour was perfectly aware of this fact, and did not conclude to assume the value of "S" as constant without careful reflexion, which satisfied him that there were counteracting causes which in a very great degree balanced or neutralized the increase of the evaporating power by an increased velocity of the engine; and that for all practical purposes, an average power, at a medium velocity, with which the traffic upon most Railways is carried on, would be quite sufficiently accurate. This is evident from his remarks, when treating the subject of the Blast-pipe, through which the steam is rejected. "Thus the power of this additional means will be greater in proportion, as the velocity of the Engine itself will be more considerable. If, for instance, the Engine travels 30 miles an hour, the velocity of the jet will be 195 miles an hour, or 286 feet per second; and as that velocity cannot be produced merely by the tendency of the steam to escape into the atmosphere, a part of the power of the Engine itself must necessarily in great speeds be spent in expulsing the steam; that is to say, in blowing the fire in the fire-place. *Consequently the increase of effect being produced at a sacrifice of power, a point will naturally come where the profit is balanced by the expence required to attain it, and there all advantage will cease.*

This question has also occupied the attention of some of the ablest English writers on the subject of Railways and Locomotive Engines. Mr. Wood, as early as 1832, in the second edition of his work on Rail Roads, in speaking of the relative evaporation of Locomotive Engines at different velocities, says. "But as in this case the piston moves at a correspondingly increased velocity, thereby producing a diminution of effect, and there also being an increase of resistance from the air at greater velocities, perhaps in the absence of experiment to prove the amount of all these forces, *we ought in practice to suppose the power of the Engine constant.*"

But in the third and much improved edition of the same work, (published in London, 1838,) this able and experienced writer treats the same subject much more fully, and examines with his usual good judgment and acumen, the position which De Pambour has taken with regard to the evaporating power of Locomotive Engines; and as Mr. Wood has there expressed, in the fullest and clearest manner, all that we could wish to have said in reply to Mr. Johnson's argument, we may be excused for inserting his remarks here at length.

"As the subject of determining the relative evaporation at different rates of speed, is of great importance in the investigation of the power of these Engines, *we shall in our calculations of the useful results produced in practice, suppose the power of evaporation constantly the same at all rates of speed*, until we have an opportunity of more conclusively determining the evaporation at different rates of speed."

"In adopting this mode of calculation at a medium velocity, we keep below the real powers of these Engines, as when the Engines travel at a greater rate of speed than the average rate adopted, the evaporating power will be greater than that given in this table. *We are the more disposed to come to this conclusion, inasmuch as in our calculations of the powers of these Engines, we have not taken in account the increased resistance of the steam passing from the cylinders, arising from the contraction of the discharging pipe into the chimney, to produce the necessary draught of air through the fire, at different rates of velocity.* These two, will in some degree balance each other; the resistance to the free discharge of the steam into the chimney will increase, as the velocity of the discharge is increased, while on the other hand the degree of evaporation will, likewise, at the same time, be correspondingly increased."

"We have made some experiments to ascertain the resistance arising from the contraction of the blastpipe at different rates of velocity, but these have not been sufficiently varied to produce results on which we could found calculations satisfactory to ourselves; until therefore experiments are made to determine both these effects accurately, at the different rates of speed requisite to form a correct conclusion, *we shall as before stated, assume the evaporation of the steam by the Locomotive Engines to be constant, allowing the effect of the increase at the higher rates of speed, to be counteracted by the increased obstruction of the steam in its passage through the blast-pipe into the chimney.*"

"Mr. Pambour calculates, that in applying this to practice, we should not take the effective evaporation at more than three-tenths of a cubic foot of water for each square foot of surface, to allow for the waste of steam through the safety valves. the loss by part of the water being thrown out into the cylinders mixed with the steam, and from other causes. *By adopting this as a standard, we are of opinion, adequate allowance is made for the loss by all the above causes.*" (*Vide* Wood's 3rd edition, pages 529 to 531.)

From this copious extract, we see that Mr. Wood entirely adopts the results deduced by Mr. Pambour, after giving them the most careful consideration; not only as regards the propriety of taking the evaporating power of Locomotive Engines as constantly the same under all practical velocities, but also as respects the amount of *effective* evaporating power, or rather the estimate of loss of steam through the valves and other causes, as established by Pambour, not as Mr. Johnson asserts by mere "arbitrary assumption," but from a series of experiments on the rising of the valve. And surely the opinion of no one is entitled to more confidence on these subjects than that of Mr. Wood, who combines with the greatest skill and experience the best opportunities for practical research and investigation.

Thus we think we have fairly, and as briefly, as the nature of Mr. Johnson's arguments would permit, met all the objections raised by him against De Pambour; in doing which we have neither been "over hasty" nor "captious," as Mr. Johnson terms our review of his first communications, but rather exercised a considerable share of patience in following him through the labyrinth of his errors and confused conceptions.

New-York, November 29, 1838. C. E. Detmold.

### *Society of Civil Engineers of the United States.*

We have frequently spoken on this subject with gentlemen of the profession. It is generally agreed that the establishment of such a society will be much to the benefit of all its members, as well as to the public generally.

During our late excursion to the South, we received from several Engineers an opinion favorable to the organization of such a society, and we had intended laying this subject before our readers, with a request to them to express their opinion upon the subject.

Before we were able to do so, we received the following communication, which we recommend to the earnest attention of our readers.

We respectfully solicit the opinion of the profession generally upon this subject.

"At an accidental, though somewhat numerous meeting of Civil Engineers, at the city of Augusta, Georgia, it appearing to them that great good might be expected to result to the cause of Internal Improvement, throughout the country, and the usefulness and respectability of the Profession of Engineering enhanced, by a frequent and free interchange of opinions, and the recital of their experience; the following resolutions were adopted:

"Resolved—That for the reasons above recited, the Civil Engineers throughout the country, be invited to convene at the city of Baltimore, on the second Monday in February next, (1839) with a view to the formation of a Society of Civil Engineers of the United States.

"Resolved—That in accordance with the foregoing Resolution, the members of the profession here present, will assemble at the time and place therein specified.

"Resolved—That the proceedings of this meeting be printed in the form of a Circular, and that each of us will use his efforts, by a distribution of the same among the members of the profession generally, to cause a full attendance on the Convention.

Augusta, Ga., October 17, 1848.

Among those present, were Engineers from Massachusetts, Alabama, Georgia, New-York, North and South Carolina, Tennessee, and Kentucky.

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### *Report of the Survey and Examination of a Route for a Railroad from Bridgeport, in the direction of New-York City, to Sawpits Village By* R. B. Mason, *Chief Engineer of the Housatonic Railroad.*

Engineer's Office, Bridgeport, November 22, 1838.

*To the President and Directors of the Housatonic Railroad Company:—*

Gentlemen,—I respectfully submit, in the following Report, the result of the survey and examination of a route for a Railroad from Bridgeport, in the direction of New-York City, to Sawpits Village.

The survey and measurement was commenced at the junction of Wall and Water streets, in the city of Bridgeport. After passing through the latter street into the outskirts of the city, we pursued nearly a west course crossing the New-York and Boston Turnpike, two miles from Bridgeport, and passing a short distance north of the main street in the village of

Fairfield; thence running parallel to, and near the turnpike, to Mill Creek, and recrossing it near Southport; thence passing by Green's Farms, Cumpo Comers, to Saugatuc River, which our line crosses at a favorable point about one and a half miles south of Westport; thence pursuing nearly a direct line to Norwalk river, at Old Well, the east bank of which is fourteen miles from our starting point. The most prominent point of expense, in grading this part of the line, occurs at a high ridge crossing our course nearly at right angles between the Saugatuc and Norwalk rivers. In crossing this ridge, we adopted a grade of 40 feet per mile, which is our maximum grade, and is not considered objectionable, as it seldom exceeds a mile in distance at one point, and can generally be located on a very direct line.

A portion of the expense in crossing this ridge may be saved by ascending diagonally along its eastern slope, and crossing a little farther south.

From Norwalk river, our course was nearly south-west, for about one mile, gradually ascending to the top of a ridge, thence descending to Five Mile river, which we crossed about a half a mile north of the landing. In crossing the ridge between Norwalk and Five Mile river, there occurs another expensive point in grading, having a cut of forty-two feet at the highest point; the ridge, however, is very short, as it falls below our grade on each side, in a distance of ten chains from the summit. From a subsequent examination by the eye, I found this ridge descended rapidly towards the Sound, and might be crossed about a half a mile farther south, on a lower grade, and with less cutting. From Five Mile river, our line was conducted to the Short Rocks, about one mile in advance, which at first presented a very forbidding appearance, but upon mature examination a route was discovered near the Salt Marsh, avoiding almost entirely all rock cutting, and introducing us, by a short cut of fourteen feet, to Good Wife's river, which our line crossed about ten chains north of Darien Landing. In our course thence to the village of Stamford, we passed near Hawley and Sanford's Mills, crossing on, or near, their dam, and continuing directly across a high ridge of land between there and Stamford.

Appearances are more favorable for continuing a line from Darien Landing farther north, crossing at the head of Hawley and Sanford's Mill Pond, and running diagonally along the eastern slope of the ridge. This location would increase the distance about ten chains, but it would enable us with the same grade to gain a higher elevation for the summit of the Road, and consequently, lessen the cut at that point. At Stamford village, our line is from ten to fifteen chains south of the main street, crossing Stamford river north of the landing; thence we pursue a south-west course for the distance of one mile, which brings us to the summit of the ridge west of Stamford; thence our line runs north of west, passing over a rocky, uneven surface, and crossing the head of a swamp near Old Greenwich; thence south-west, passing near the church, and crossing another ridge to Miamus river, over which our line passes between the two landings.

From Stamford to this point, on the route surveyed, there would be a succession of deep cuts and heavy embankments, which I do not hesitate to say, may be materially lessened, by continuing the line farther south, where the country presents a more uniform surface. From Miamus river, our line was conducted over a low flat, lying directly in our course to the head of Davis' Mill Pond. At this point, we commence the ascent of Puts' ridge, on the summit of which, we encounter a cut of thirty-two feet, falling off to grade on each side in a distance of five chains. This point is twenty-eight miles from Bridgeport, and about three-fourths of a mile from Rocky Neck landing.

From Puts' ridge, our course is very direct through a natural ravine to the summit of the next ridge, where we have a short cut of twenty feet in depth, apparently free from rock; thence passing over a broken, uneven surface to the summit of the next ridge, where by a short cut of twenty-three feet in depth, we are brought to the valley of Byram river, on the east bank of which, opposite Sawpits village, our survey was terminated. This point was found to be thirty miles and twenty-eight chains from our starting point in the city of Bridgeport. From Sawpits to Harlaem, I ascertained the distance to be about twenty miles, and from my knowledge of the country, I feel warranted in saying that the construction of a road between these two points would be entirely practicable.

The entire route from Bridgeport to Sawpits would be a succession of long straight lines, and easy curves, in no instance less than one thousand feet radius. My time being limited, an instrumental examination was made of one route only; although the features of the country are such, that at some points several routes appear to possess nearly equal advantages, each of which should be carefully examined. The following table will show the condition of the line, in respect to its grades, as they occur in passing from Bridgeport to Sawpits.

| No. of Grades | Location. | Length of Grades in Chains. | Total distance from Bridgeport Miles, Chains | Ascent per mile in feet. | Descent per mile in feet. |
|---|---|---|---|---|---|
| 1 | Water Street | 21 | 0·24 | Level | |
| 2 | Bridgeport and Fairfield line | 36 | 0 60 | 20 | |
| 3 | New-York and Boston Turnpike | 100 | 2·00 | Level | |
| 4 | Near Turnpike | 24 | 2·24 | 30 | |
| 5 | do do | 4 | 2 28 | Level | |
| 6 | Across Ash Creek | 40 | 2·68 | | 24 |
| 7 | to station 71 | 56 | 3·44 | Level | |
| 8 | Small Creek | 24 | 3 68 | | 20 |
| 9 | in Road | 32 | 4·20 | Level | |
| 10 | Fairfield Village | 36 | 4·56 | 20 | |
| 11 | Mill Creek | 76 | 5·52 | Level | |
| 12 | near Southport | 20 | 5 72 | 40 | |
| 13 | do do | 4 | 5 76 | Level | |
| 14 | do do | 36 | 6 32 | | 40 |
| 15 | do do | 4 | 6·36 | Level | |
| 16 | Gravel Ridge | 16 | 6 52 | 30 | |
| 17 | do do | 28 | 7·00 | Level | |
| 18 | do do | 40 | 7·40 | 30 | |
| 19 | do do | 12 | 7 52 | Level | |
| 20 | do do | 32 | 8 04 | | 30 |
| 21 | Old Road | 4 | 8·08 | Level | |
| 22 | Green's Farms | 36 | 8·44 | 40 | |
| 23 | do do | 4 | 8·48 | Level | |
| 24 | Fairfield and Norwalk line | 76 | 9 44 | | 30 |
| 25 | on Marsh | 24 | 9·68 | Level | |
| 26 | Cumpo Corners | 80 | 10 68 | 20 | |
| 27 | do do | 4 | 10·72 | Level | |
| 28 | Saugatuc River | 28 | 11·20 | | 30 |
| 29 | in Swamp | 52 | 11·72 | Level | |

| No. of Grades | Location. | Length of Grades in Chains. | Total distance from Bridgeport Miles, Chains | Ascent per mile in feet. | Descent per mile in feet. |
|---|---|---|---|---|---|
| 30 | In Swamp | 4 | 11·76 | 20 | |
| 3[illegible] | Summit of Ridge | 80 | 12·76 | 40 | |
| 32 | do do | 4 | 13·00 | Level | |
| 33 | Norwalk River | 84 | 14·04 | | 40 |
| 3[illegible] | do do | 12 | 14·16 | Level | |
| 35 | Summit of Ridge | 112 | 15·48 | 40 | |
| 36 | do do | 8 | 15 56 | Level | |
| 37 | past Five Mile River | 108 | 17·04 | | 40 |
| 38 | do do | 4 | 17 08 | Level | |
| 39 | on Short Rocks | 44 | 17·52 | 40 | |
| 40 | do do | 8 | 17·60 | Level | |
| 41 | on Salt Marsh | 64 | 18·44 | | 40 |
| 42 | do do | 4 | 18·48 | Level | |
| 43 | Good Wife's River | 24 | 18·72 | 30 | |
| 44 | do do | 12 | 19·04 | Level | |
| 45 | past Darien Landing | 20 | 19·24 | 40 | |
| 46 | do do | 4 | 19 28 | Level | |
| 47 | Salt Marsh | 36 | 19 64 | | 20 |
| 48 | Darien and Stamford line | 24 | 20·08 | Level | |
| 49 | Summit of Ridge | 72 | 21·00 | 40 | |
| 50 | do do | 4 | 21·04 | Level | |
| 51 | Stamford Village | 72 | 21·76 | | 40 |
| 5[illegible] | do do | 24 | 22·20 | Level | |
| 53 | Stamford River | 32 | 22·52 | 30 | |
| 54 | Summit of Ridge | 84 | 23·56 | 40 | |
| 55 | do do | 4 | 23 60 | Level | |
| 56 | Old Greenwich | 68 | 24·48 | | 40 |
| 57 | do do | 4 | 24 52 | Level | |
| 58 | Summit of Ridge | 52 | 25·24 | 40 | |
| 59 | do do | 4 | 25·28 | Level | |
| 60 | Miamus River | 56 | 26·04 | | 40 |
| 61 | do do | 8 | 26·12 | Level | |
| 62 | in Meadow | 28 | 26·40 | | 40 |
| 63 | do | 4 | 26·44 | Level | |
| 64 | in Swamp | 28 | 26 72 | 20 | |
| 65 | do | 20 | 27·12 | Level | |
| 6[illegible] | Davis Mill Pond | 16 | 27 28 | | 40 |
| 6[illegible] | do do | 8 | 27·36 | Level | |
| 6[illegible] | Puts Ridge | 44 | 28·00 | 40 | |
| 69 | Past Road | 24 | 28·24 | Level | |
| 7[illegible] | Summit of Ridge | 72 | 29·16 | 40 | |
| 71 | do do | 8 | 29·24 | Level | |
| 72 | Byram River. | 84 | 30·28 | | 40 |

RECAPITULATION OF GRADES.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7 | miles, | 60 | chains, | Level. | | | |
| 2 | " | 24 | " | 20 | feet ascent | per mile. | |
| 1 | " | 56 | " | 30 | " | " | |
| 7 | " | 76 | " | 40 | " | " | |
| 0 | " | 60 | " | 20 | descent | " | |
| 0 | " | 40 | " | 24 | " | " | |
| 1 | " | 56 | " | 30 | " | " | |
| 7 | " | 56 | " | 40 | " | " | |
| — | | — | | | | | |
| 30 | " | 28 | " | | | | |

The following estimate is based upon a grading sixteen feet wide for a single track. The slopes to be one foot and a half base to one foot rise. Where rock occurs, the road bed is estimated at fourteen feet in width, slope half a foot, to one foot rise.

Embankments to be fourteen feet wide, grade with slopes the same as in earth excavation.

The face work of the masonry for large structures to be neatly hammer-dressed range work, and all to be of the most permanent character —The superstructures for the bridges are estimated upon Col. Long's plan, and in crossing navigable waters, ample provision is made in the estimate for draws of the most approved construction to admit the passage of vessels. Turnouts of suitable length are estimated for every five miles, and the road to be prepared for locomotive power. The estimate is confined to the route examined with the instrument, although I am perfectly satisfied a very considerable saving of expense may be made by the alterations referred to.

The estimate of grading will be given in sections comprising each a town through which the line passes, commencing at Bridgeport, and extending westwardly to its termination.

BRIDGEPORT SECTION, No. 1.

This section commences at the junction of Wall and Water-streets in he city of Bridgeport, and is sixty-four chains long.

| | | |
|---|---|---|
| Excavation, - - - - - | $447 60 | |
| Embankment, - - - - - | 364 80 | |
| Culverts and Drains, - - - - | 350 00 | |
| Road crossings, - - - - - | 75 00 | |
| | | $1,237 40 |

FAIRFIELD SECTION, No. 2.

This section extends through the town of Fairfield, and is eight miles and fifty-six chains long.

| | | |
|---|---|---|
| Excavation, - - - - - | $7.190 90 | |
| Embankment, - - - - - - - | 14,549 76 | |
| Rock, - - - - - - - - - - | 5,516 00 | |
| Bridges, Culverts and Drains, - - | 12,120 00 | |
| Road and Farm crossings, - - - - | 520 00 | |
| Grubbing, - - - - - - - - | 158 00 | |
| | | $40,054 66 |

NORWALK SECTION, No. 3.

The length of this section is seven miles and sixteen chains, and includes the bridges across Saugatuc and Norwalk rivers.

| | | |
|---|---|---|
| Excavation, - - - - - - - | $20,023 66 | |
| Embankment, - - - - - - - | 20,477 81 | |
| Rock, - - - - - - - - - - | 25,148 00 | |
| Bridges Culverts and Drains, - - - | 25,285 00 | |
| Roads and Farm crossings, - - - - | 430 00 | |
| Grubbing, - - - - - - - | 912 00 | |
| | | $92,276 47 |

DARIEN SECTION, No. 4.

This section is three miles and forty chains long.

| | | |
|---|---|---|
| Excavation, - - : - - - | $4,001 58 | |
| Embankment, - - - - - - - | 8,189 53 | |
| Rock, - - - - - - - | 5,152 00 | |
| Bridges, Culverts and Drains, - - - | 11,380 00 | |
| Road and farm crossings, - - - - | 170 00 | |
| Grubbing, - - - - - - | 235 00 | |
| | | $29,128 11 |

STAMFORD SECTION, No. 5.

| | | |
|---|---|---|
| Excavation, - - - - - - | $15,229 64 | |
| Embankment, - - - - - | 19,998 14 | |
| Rock, - - - - - - | $16,052 00 | |
| Bridges, Culverts and Drains, - - | 14,130 00 | |
| Road and Farm crossings, - - - - | 295 00 | |
| Grubbing, - - - - - - - - - | 280 00 | |
| | | $65,984 78 |

GREENWICH SECTION, No. 6.

This section is six miles and eight chains long, and terminates a Byram river.

| | | |
|---|---|---|
| Excavation, - - - - - | $14,043 02 | |
| Embankment, - - - - - | 42,577 52 | |
| Rock, - - - - - - - | 19,556 00 | |
| Bridges, Culverts and Drains, - - | 19,010 00 | |
| Road and Farm crossings, - - - - - | 315 00 | |
| Grubbing, - - - - - - - | 526 00 | |
| | | $96,026 54 |

RECAPITULATION.

| Sections, | Length in miles | and chains, | Amount. |
|---|---|---|---|
| Bridgeport, - - - | 0 | 64 | $1,237 40 |
| Fairfield, - - - - - | 8 | 56 | 40,054 66 |
| Norwalk, - - - - - | 7 | 16 | 92,276 47 |
| Darien, - - - - | 3 | 40 | 29,128 11 |
| Stamford, - - - - | 4 | 04 | 65,984 78 |
| Greenwich, - - - - | 6 | 08 | 96,026 44 |
| | 30 | 28 | $324,707 96 |

Whole distance, 30 miles, 28 chains.

Whole amount as above, $324,707 96 = $106,99 12 per mile.

SUPERSTRUCTURE.

I assume as a model the ordinary wooden superstructure, having longitudinal sills five by seven inches; cross-ties eight feet long and six inches square, with a pine rail six inches square, surmounted by an iron plate, $2\frac{1}{4}$ by $\frac{5}{8}$ inches, secured by spikes and bolts. A superstructure of this kind, with all the materials of the very best quality, I estimate to cost, including turnouts, $5000 per mile.

RECAPITULATION OF COST.

| | |
|---|---|
| Grading for single track, including turnouts, - | $324,707 96 |
| 30 miles, 28 chains of superstructure, at $5,000 per m. | 151,750 00 |
| Contingencies, Engineering, &c. - - - - | 30,000 00 |
| | $506,457 96 |

or $16,688 25 per mile.

Although I have estimated for the wooden rail and flat bar, still I would recommend the edge rail, believing it to be sound economy to use it on a road destined to do such an immense amount of business.

A single track edge rail, with turn-outs, including right of way, and all expenses to prepare the road for Locomotive power, may be constructed for $21,000 per mile,

A brief description of the Rail Roads in progress, will show the vast importance of this project. There is every reason to expect, that within three years from this time, an uninterrupted line of Rail Road communication will be opened from New Haven to Boston and Maine; from

Boston and Bridgeport to Lake Erie, *via* Albany, with branches uniting with these main trunks at various points.

When this shall have been done, it is easy to conjecture the immense amount of business and travel that will concentrate at New Haven and Bridgeport, seeking the great commercial metropolis of the Union, through this channel.

I would refer to some of the resources that this road, when complete, will have for its support. The present amount of travel between New York, Bridgeport, and the intermediate points, for four or five months in the year, is about 250 daily each way; for the residue of the year about 100. This, however, does not include the travel between Sawpits and New York. I have not been able to ascertain the amount of travel between the country east of Bridgeport and New York, but from the number of Steam Boats engaged on the Sound, almost exclusively in the transportation of passengers, we can readily conceive the number must be several hundred each way daily. During the Summer, this travel would be divided between the Steam Boats and Rail Road. But for several months in the year, a large proportion of it would seek the Rail Road.

In proof of this, I would refer to the New Jersey road, extending from Jersey City to New Brunswick, where, notwithstanding there is a daily Steam Boat from Newark, Elizabethtown and New Brunswick, their through passengers amount to about two hundred per day each way, and their way passengers to six or eight hundred.

It is presumed that a portion of the immense travel between New York and Albany, even in summer, would, for the sake of variety, take this route. The whole distance could easily be accomplished in nine hours, including all stoppages.

But whatever doubts there may be on the summer, there can be none on the subject of the winter travel between New York and Albany, which probably averages one hundred per day each way, and no doubt would be quadrupled on the completion of this route through to Albany.

The immense amount of water-power on the Housatonic, which on the completion of the Housatonic Railroad will be brought into notice, must, ere long, be improved and applied to manufacturing purposes; in consequence of which a large increase of way travel may be expected.

But independent of all this, there are other considerations which demand the construction of this road. The great chain of Railroad from Maine to New-Orleans, which is now progressing with a rapidity equalled only by its importance, would be incomplete without it.

It will be demanded for the transportation of the United States Mail, for which Railroads are so eminently calculated; possessing a superiority, as regards speed and certainty, over any other mode of conveyance.

I will not attempt a description of the importance of this Road, as connected with the interests of New-York city. From the well-known intelligence, energy and enterprise of the citizens of New-York, it may be expected they will duly appreciate the importance of an uninterrupted communication, at all seasons of the year, with such a vast extent of country.

Where, I would ask, is there a Railroad project whose benefits, when completed, would be so widely diffused, or that promises such a rich reward to the Stockholders?

My acknowledgments are due to B. B. Provoost, Esq., and Robert Ogilby, for the zeal and energy with which I was seconded by them in the accomplishment of the survey. Respectfully submitted.

R. B. MASON, *Chief Engineer of the Housatonic Railroad.*

*First Russian Railroad.*

The celebrity of the first Russian Railroad has rendered it an interesting work to Engineers; a desire is felt to ascertain the details of its construction, and we therefore give nearly the whole description, as taken from a published statement politely furnished us by the Chev. von Gerstner.

We have also been favored by an examination of the map of the road, and plans of the buildings constructed. From the contiguity of these to the Royal Palace and grounds, more architectural display was needed than we are apt to find about our own railroads. They have furnished an opportunity, however, to the gentleman constructing the work, to prove himself an able architect as well as engineer.

There are several points which we commend to the special attention of our Engineers, viz.:—The width of the track—the space cleared on both sides of the track—the immense travel in the vicinity of St. Petersburgh—and the speedy completion of the work.

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*First Russian Railroad from St. Petersburg to Zarskoe-Selo and Pawlowsk, established by imperial decree of 21st March, 1836, and carried into execution by a company of shareholders in Russia, England and Germany. Translated from the German.*

Founders and Directors of the Company.—His Excellency the Count Alexis Robrinsky, Chamberlain to his Majesty the Emperor; Benedict Cramer, Esq., Merchant, Councillor of Commerce; J. C. Plitt, Esq., Merchant, Consul to the Free Town of Frankfort-on-Maine; the Chevalier Francis Anton Von Gerstner, who is also Directing Engineer.

Capital.—Three Millions of Bank Note Rubles, in 15,000 Shares of 200 Rubles (about £9 Sterling) each, with the right of raising an additional 500,000 Rubles, if required, by the issue of 2500 new Shares.

Explanation.—1 werst=500 fathoms=3500 English feet.—1 English mile=about 1½ werst.—1 English ton=62$\frac{1}{10}$ pud.—£1 sterling=23 bank note rubles.

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The Reports on the Zarskoe-Selo Railroad, which from time to time have appeared in the Russian papers, and from thence have been copied into the foreign journals, have excited considerable interest in the public, particularly in Germany and England. No undertaking of the same class has hitherto made such rapid progress as this railway, which, called into existence by the especial patronage of the Emperor of Russia, and endowed with most extensive privileges, precludes all doubt of its proving eminently successful and advantageous to the shareholders. In a few days subsequent to the Imperial Grant being obtained, the company of shareholders was formed, and the whole capital (three millions of rubles) subscribed. The payments of the calls upon all the shares issued, were made with punctuality, and no single instalment remained in arrear. Within six months and six days from the time the decree received the imperial sign-manual, the requisite supply of rails and materials, carriages and machinery, was obtained from England; most of the works on the entire length of line, 25½ wersts, were completed, the rails partly laid down, and three wersts opened by horse power. Six weeks later the opening of a distance of 7½ wersts, with locomotives, took place; and this summer (1837) the whole of the line, from the centre of the capital to the terminus in Pawlowsk, will be opened.

This rapid progress of the undertaking, which in other countries would have been the work of several years, naturally excited the attention both of natives and foreigners.

That portion of the English public which takes a general interest in railways, expressed a desire to obtain the Reports which have hitherto appeared, that they might be enabled to investigate the circumstances that led to so extraordinary a result in Russia; another portion, better acquainted with the favorable state of the Russian share market, with a view to partake in this new speculation:—but as the publications of the Chevalier von Gerstner—viz.

*Memoir on the advantages of a Railroad from St. Petersburg to Zarskoe-Selo and Pawlowsk, 20th March*, 1836.

*First Report on the progress of this Railroad, 20th July*, 1836;

*Second Report on the same, 22nd September*, 1836;

have for some time been out of print; the

*Third Report, 29th January*, 1837, which has reference to the preceding, would hardly be understood by many readers. The purport of the present paper is, therefore, to lay before the public in this country a clear statement of facts relative to the Zarskoe-Selo railway, to assist them in forming a correct opinion of the enterprize, and in entering into it, as well as into other manufacturing concerns about to be carried into effect in Russia. It will tend, at the same time, to give a more expanded view of the internal constitution of that colossal empire, and to correct the erroneous opinions that have been induced by a defective knowledge of its actual condition.

Peter the Great, the immortal founder of the power and greatness of the Russian empire, felt how necessary to its welfare was the improvement of its communications; he had witnessed in Holland the beneficial influence of canal traffic; he visited the interior of his empire, and himself planned the whole of the water communications which were, either during his reign or afterwards, carried into execution. This Sovereign introduced *Canals* because, in the then existing state of knowledge, they were considered as the most perfect channels of internal communication. Alexander I, introduced artificial *Roads*. He commenced with the first turnpike road from St. Petersburg to Moscow, a distance of about 700 wersts, the smallest portion of which only was accomplished when death overtook this monarch; but his successor, the reigning Emperor Nicholas I., carried out the project; in a few years finished the road to Moscow; and caused surveys to be made for a complete system of roads, intended to intersect the whole interior of the empire, which, under his happy reign, is now making such rapid advances in prosperity.

The progress which *Railroads* had made in modern times did not escape the scrutinizing view of the Sovereign. The Chevalier von Gerstner went to Russia in August, 1834, with the intention of visiting the interior of the country, and informing himself respecting its manufactories and mines. The Emperor Nicholas heard of this, as well as that so early as

7th September, 1824, the Chevalier had obtained a privilege from the late Emperor Francis of Austria, to construct a railroad between the Moldau and Danube; that for four years, up to 1828, he conducted the works on this line, comprising, with its continuation from Linz to Gmunden, a total length of 130 English miles, over which the traffic continues in summer and winter without interruption. The Emperor in consequence, in September, 1834, expressed a desire to see a line of railway from St. Petersburg to Moscow executed, if possible, by a company of shareholders.

After the Chevalier von Gerstner had, in the beginning of 1835, finished his tour to the manufacturing provinces, he was presented at the Court of St. Petersburg, when the Emperor, with great earnestness, and with the penetration for which he is so remarkable, expressed himself strongly as to the advantages that would result from the introduction of railways into Russia, and the extraordinary privileges that the first undertakers might expect.

The Chevalier von Gerstner in consequence proposed to commence with two short lines, the first from the interior of St. Petersburg to the towns of Zarskoe-Selo and Pawlowsk, and the second from the same point in the capital to Peterhoff and Oranienbaum.

The negociations for the grant lasted to the end of the year 1835, when, on the 21st December, the President of the Council, in the name of the Emperor, communicated to M. von Gerstner that he was thenceforth invested with the *exclusive* personal privilege of *incorporating shareholders for the execution of both railways.*

The Chevalier von Gerstner hereupon joined the three other Directors and Founders of the company of shareholders, whose names have been given above, for the execution of the first line, from St. Petersburg to Zarskoe-Selo and Pawlowsk, whilst he reserves to himself the right of forming the company for the line to Peterhoff.

The demand for shares, on the undertaking of the enterprize being made public, was so great that the first 15,000 shares, or the original capital of three millions rubles, were subscribed for almost immediately; chiefly by the Russians and naturalized Germans, although persons residing abroad may participate, without any restriction. The latter may either appear in person at the general meetings, or be represented by their agents, and receive their dividends the same as the Russian subjects, without any deductions or the payment of any duties to the state.

The Imperial Grant for the Zarskoe-Selo railway is dated 21st March, 1836. The privileges thereby conceded to the company are very considerable, such as were never granted to any railway company in any country before. The execution of the railway is regarded as if undertaken immediately by the Crown; the Crown lands have been gratuitously ceded to the company; the farmers holding lands that were required, have been appointed to other ground, and are compensated by the Crown for any loss sustained by the transfer; lands or buildings, the property of private individuals, must be surrendered to the company, either by voluntary agreement or at a price to be determined by judicial valuation; but to prevent the obstruction of the works, the company, by depositing a sum of money about equal to the purchase-price of a similar plot of ground or tenement in the vicinity, have the power to take possession of such lands or tenements before the termination of the appraisement. The valuation being determined, the balance of the amount due is paid to, or received from the parties.

The company are at liberty to erect any description of buildings requisite for the railway traffic, for 100 fathoms on each side of the railway, except in the Artillery Ground, through which the line passes, and for the acquisition of which the same privileges have been granted as for that of the rest of the line. The removal of the battery, rocket manufactory and other military buildings intersected by the line, is to be effected by the company, at their cost, to another quarter. In this manner the railway without the town forms an uninterrupted straight line for 24 wersts. Within the town the straight line is only warped into two gentle curves. by following the course of the Wedenskoi canal.

The medium rise of the whole line is 1 in 1028, and the extreme 1 in 504. The railway terminus in the town is at the junction of the Wedenskoi with the Fontanka canal, on a piece of ground 80 fathoms by 42½ in breadtn, which has partly been purchased and partly ceded by the Crown. From this spot to the new boundary of the town on the Ligofka, the railway measures about 1½ mile, and will therefore, for that distance, *run within the capital*, a circumstance of the utmost importance, as affecting the number of passengers or the amount of traffic. The terminus at the other end is situated 550 fathoms within the Great Park of Pawlowsk, the property of his Imperial Highness the Grand Duke Michael Pawlowitsch. The company have been permitted to erect, in some of the finest parts of that park, several buildings for the reception and entertainment of the public; and at Zarske-Selo they have been allowed to establish an hotel at the railway station.

The company have the right to purchase the iron for the whole line, abroad, and to import the same *duty free*, provided no Russian iron work should undertake the delivery in the required quality, form, and time, and at most at 15 per cent advance upon the price at which the iron might be imported into St. Petersburg, from foreign countries. The company are further empowered to import the locomotive engines, railway carriages, and all other machinery and requirements, *duty free*.

The company are not bound to any fixed fares for the conveyance of passengers, or rates for the carriage of goods, but are at liberty to fix them at discretion. The railway remains *for ever* the property of the company: during the first ten years no one can make a railroad in the same direction; and during the same term of ten years the company are exempted from the payment of rates and taxes of every description, either to the Post Administration or any other authority The capital of the company is covered by 15,000 shares of 200 bank note rubles each; if necessary, 2500 more shares may be issued for raising the reserve fund of 500,000 rubles; all the 17,500 shares, however, participate alike in the profits of the undertaking. *The number of shares can in no case be augmented.*

Eight days after the grant had been made out, the Chevalier set out from St. Petersburg for England and Belgium, for the purpose of ordering the necessary rails, engines, carriages, and other railway machinery, as no one could be found in Russia to contract for these materials in the stipulated time.

It was exceedingly difficult to obtain them in England last year, as the iron works there, in consequence of the many English and American orders, were occupied literally night and day, and most of them had employment for a year or two in advance, in consequence of which the price of rail bars had been raised upwards of 40 per cent. within a twelvemonth. Another difficulty arose from the Chevalier having altered the *width* (or the distance of the two rails upon which the carriages run) of the Russian railroad, from that established in England. On the old English railroads only goods of small bulk and great weight were transported, such as iron, coals, stones, bricks, &c , but not sheep's wool, hay, straw, or fire wood. In 1822, when the railway between Stockton and Darlington was begun, which was first intended for a general trafic of passengers and goods, Mr. George Stephenson, the engineer, established the breadth of the track between the rails at 4 feet 8½ inches English, as being the width of the track of carriage-wheels on high roads. Experience has shown how inconvenient this arrangement is for the locomotive engines, which in England, usually of 15 to 18 horses' power, are by this narrow gage confined within about four feet, which *is by far too little for such an engine.* The driving wheel can at most have but a diameter of five feet, as otherwise it would lurch too much; in order, therefore, to do 30 miles an hour, it must make 168 *revolutions* in a minute The strain and wear and tear of all the parts of a locomotive, by reason of the quick motion of the driving wheel, and more particularly the cramped arrangement of the individual parts, are therefore very considerable.

The disbursements in the coaching and carrying departments on the Liverpool and Manchester railway, upon an average of the last three years, amounted to 44 per cent., and the repairs of the locomotive to 56 per cent. of the total expenditure, originating in their wear and tear as a tractive power. This charge must naturally be far less in a wider gage. If cattle and bulky materials, such as sheeps' wool, straw, hay, firewood. travelling carriages, &c., are to be conveyed, the load cannot be stowed between the wheels, if the gage is only 4 to 8½ inches, but must be placed in a box or on a platform 6 to 8 feet wide, by which, the base being only half as large as the superstructure, great lurching is necessarily occasioned, particularly at high velocities; and moreover, especially in rough weather, high loaded waggons, with a confined base, are apt to have the flange of the wheels rub up against the rails, thereby occasioning great increase of friction, wear and tear. The trains generally run the distance between Manchester and Liverpool in 1¼ to 1½ hour, whereas in a high wind those laden with cotton wool take three hours for the journey, which would not be the case if a wider gage had been adopted. Increase of axle friction cannot take place on a wider gage, as in all railway carriages the friction is now no longer between the wheels, but on the outside, on the projection of the axle through the wheel.

These and other reasons induced the Chevalier von Gerstner to *adopt a gage of six feet English between the rails;* but the consequence was, that for the locomotive engines, turnplates, and machinery, new drawings and models had to be prepared, before the construction of the machinery could be commenced. The deliveries thereof last year were in consequence attended with considerable difficulty; but connexions of many year standing, which the Chevalier von Gerstner had in England, enabled him to overcome these difficulties, and in the Third Report there occurs the following account of the rails, chairs, &c. imported duty free into Petersburg.

Besides the above rails, a small parcel, ready in autumn, remained behind in England, for want of an opportunity to ship it, and cannot arrive in St. Petersburg until the spring.

| | | | | | |
|---|---|---|---|---|---|
| The weight of the rails delivered is | | | 1727 tons | 6 | cwt. |
| " | " | pedestals and blocking pieces | 656 " | 4 | " |
| " | " | pins | 38 " | 8 | " |
| " | " | wedges | 16 " | 1 | " |

With respect to the rails, it may be observed that they are of a parallel form, have the top and bottom shaped alike, and weigh 65 lbs. per yard; the general length of a rail is 15 feet, though some few are 12 feet.

Independently of the iron masters contracted with being of the first respectability, the punctuality with which the rails, chairs, &c. were delivered, may perhaps be partly ascribed to the circumstance mentioned in the Chevalier von Gerstner's First Report, that to each contract a penalty of 5*l.* per day for every instance of non-delivery was attached; on the other hand, the iron masters received a considerable payment on account —upon an average, one-third of the whole amount of the contract. In making the rails from the rough or puddled bars, they were cut into lengths, heated in the welding or balling furnace, and then rolled into rail bars, and consequently were what is called thrice worked, or best quality.

The Chevalier von Gerstner, besides these, ordered six locomotive engines in England, of which, three were to be delivered in the autumn of 1836, and the remainder in the spring of 1837. The prompt delivery of the former was insured by a penalty of 500*l.* if the work was delayed even for a single day beyond the time. The locomotive and tender of Messrs. Robert Stephenson & Co., in Newcastle on Tyne, cost 1875*l.*; that of Mr. Timothy Hackworth, of New Shildon, 1700*l.*, both inclusive of charges to the vessel. Mr. Cockerill delivered a locomotive and tender at St. Petersburg for 40,000 francs The diameters of the steam cylinders were 14 inches; whereas those in the English railroads are only 12 inches: the power of the Russian engines is consequently one third greater than in the English, which have thirty to thirty-five horses' power.

To be continued.

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*Specification of a Patent granted to* ARCHIBALD RICHARD FRANCIS ROSSER, *of New Boswell Court, in the County of Middlesex, Esquire, for Improvements in Preparing Manure, and in the Cultivation of Land.*— Sealed August 2, 1837.

To all to whom these presents shall come, &c. &c.—*Now know ye* that in compliance with the said proviso, I, the said Archibald Richard Francis Rosser, do hereby declare the nature of the invention is described and ascertained, in and by the following statement thereof (that is to say:—

The invention relates to a mode of reducing into manure, and applying the same to the cultivating and fertilizing of land, whereby land may be dressed, cultivated, and manured with greater advantage than has heretofore been practised, not only broom, heather, furze, rushes, and other vegetables not hitherto used for making manure, as being deemed too difficult of decomposition, but also vegetables and weeds, such for instance as couch grass, which it has hitherto been considered dangerous to introduce into manure, and the vegetating powers of which are by the invention totally destroyed. The principal object effected by the invention is the production of a rapid fermentation, the degree of which may be regulated nearly at pleasure, whereby the substances to be converted into manure are speedily and uniformly decomposed. The inventor found it very convenient and effectual for facilitating the conversion of substances into manure, to prepare a liquid beforehand, which he called *eau et saturer*, and which I will call saturating water. This saturating water may be conveniently prepared thus; form a tank or a water tight pit, proportioned to the dimensions of 12 feet long, by 6 feet broad, and 6 feet deep; fill the tank to the extent of half its depth with water, throw in such herbaceous or even woody plants as may be within reach, taking care to make use in preference, of those containing the most unctuous and mucilaginous parts. With these plants and the water the tank is to be filled up to the extent of three-fourths of its depth; add, of the nearest earth or soil, sufficient only to leave one foot in depth of the tank unoccupied, then put in 10 pounds of unslacked lime and 5 ounces of sal ammoniac. The tank may afterwards be filled and kept full with kitchen water or any sweepings, dead animals, spoiled provisions and filth from the dwelling-house. The contents of the tank should be stirred together from time to time. Should much unpleasant odour be evolved or insects be produced, more unslacked lime should occasionally be added. The next thing to be done is to prepare a smaller water tight vessel, tank, or pit, into which are to be thrown a sufficient quantity of the saturating water to dissolve or mix the ingredients after mentioned, or if there is no saturating water prepared, water as impure and putrid from animal and vegetable substances as can be conveniently procured.

The inventor calls this water mixed with the matters next mentioned, a lessive. By the words fecal matters or fecal substances hereafter used, I mean human ordure. About 130 gallons of the lessive may be prepared for the conversion of 1000 lbs. of straw or 2000 lbs. of green woody fibrous vegetable substances, into 4000 lbs. of manure. The lessive, with the sufficient quantity of saturating water or impure water before mentioned, may be composed of the substances following, and in about the following proportions, that is to say. 200 lbs. of fecal substances and urine (the greater the proportion of fecal matter the better), 50 lbs. of chimney soot, 400 lbs. of powdered gypsum, 60 lbs. of unslacked lime, 20 lbs. of wood ashes not lixiviated, 1 lb. of sea salt, 10 ounces of refined salt petre, and 50 lbs. of what the inventor called levain d' engrais, and I call leaven of manure, being the last drainings from a preceding operation where there has been one. The saturating water is to be well stirred till it is thick, and a portion of it is to be immediately poured into the lessive tank into which are to be thrown the lime, the soot, then the ashes, then the fecal matters, the salt, and afterwards the saltpetre. The gypsum is to be thrown in powdered, little by little, always stirring the mixture lest it should cake; when the whole is well mixed by stirring, the leaven of the manure is to be added.

Although I have mentioned various primary or preferable substances for the composition of the lessive, yet where these cannot be used with due regard to economy. substitutes may be employed. For the fecal substances and urine, 250 lbs. of the dung of horses, oxen, cows, or pigs; or 100 lbs. of the dung of sheep or goats, for the chimney-soot; 100 lbs. of the burnt, baked, or roasted earth, for the gypsum; the same weight of river mud, hill-side mud, sea-mud, fat earth from woods or forests, marl or dust, or mud, of the high road; for the wood ashes not lixiviated, 50 lbs. of wood ashes lixiviated, or two pounds of potash; for the sea-salt, 100 lbs. of sea-water; for the refined saltpetre, any quantity of rough saltpetre or common saltpetre, or mother water of saltpetre, containing 10 ounces of pure saltpetre. Whenever the quantity of a lessive fails for a making, or runs short, it is to be made up with the saturating water, and that again with water, always using the most impure and putrid from animal and vegetable matters that can be obtained. In the place where the substances to be converted into manure are to be heaped for that purpose, the surface of the ground is to be rendered impervious to liquids by beating, paving, or otherwise, in such a manner as that the liquids running from the heap may flow unabsorbed into pits or reservoirs placed or constructed at a lower level. For making the heap, straw may be used; whole furze broom and other woody stalks may with good effect be cut into lengths of from 6 to 8 inches, or bruised, that they may pack the closer, and retain the lessive the better. It is very advantageous to throw the vegetable substances to be reduced into manure into a vessel, tank, or pit, containing a quantity of the lessive, the lessive having been previously made as muddy as possible by stirring. The substances are to be trodden or beaten among the lessive; and as fast as they are well soaked and slimed all over, they are to be thrown upon the heap. The heap may be conveniently made 7 feet high, and upon every layer of a foot deep, there should be thrown in a drenching of the lessive, first stirring it well. When the heap is raised to its full height, the muddy sediment of the lessive (which has not been stirred up into the liquid) is to be spread equally over the top surface of the heap. The top of the heap should then be covered with straw, old planks, branches, or herbage, or any other suitable matters. While the heap is making, it should be beaten or trodden down, so as to make the substances of which it is composed lie close and compact; and when it is finished, it should be beaten all round with the same view. At the end of 48 hours from the completion of the heap, a fermentation of from 15 to 20 degrees of heat, by Reaumur's scale, has been found to have taken place; and on the following day it has generally attained from 30 to 40 degrees of Reaumur On the third day, the top of the heap is to be opened to 6 inches deep with a fork, and the sediment thrown on the top is to be turned over, and another good drenching with the lessive is to be applied to the heap, which is again to be immediately covered up; about the seventh day, holes about 6 inches distance from each other are to be made with a fork to the depth of 3 feet, and another drenching is to be applied, the heap being afterwards covered up again. About the ninth day, another drenching is to be applied through new and somewhat deeper holes, and the heap is to be again covered up. After the lapse of from 12 to 15 days from the making of the heap, the manure will be fit to spread. The fermentation is stopped by an excessive drenching, or by opening out the heap. If the materials of the heap are straw only, the fermentation may be stopped at 55 degrees of heat, otherwise it may be allowed to proceed to 75 degrees. All the draining should be carefully collected and used over and over again, for the drenchings and residue should be preserved for subsequent makings. In all processes of fermentation, it necessarily happens that variations of heat and time take place according to the temperature of the atmosphere, and the materials acted upon, and other causes. And it is advisable not to make the heap in very cold weather; but the inventor found that the process here laid down was the best for suitable fermentation, which, after numerous experiments made during many years, he could devise. The experienced farmer will, in the composition of his lessive, have regard to the nature of the soil to which the manure is to be applied, and put into the lessive, more or less of lime, or the alkalies for instance, according as the soil is of a warmer or colder nature.

The invention consists in the composition of the lessive and the process of repeatedly using the lessive for producing fermentation, which may be regulated nearly at pleasure, although the proportions of the materials composing the lessive may be reasonably varied, and although such variations may in some degree retard the required decomposition of the heap. —In witness whereof, &c

Enrolled February 2, 1837.

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*Abstract of Papers read at the Institution of Civil Engineers.*

"Additional Remarks on the Canal Lifts of the Grand Western Canal, by James Green."

If the trade of the canal were all downward, there would, by the use of these lifts, be carried from the lowest to the highest level of the canal a quantity of water equal to the loads passed down

Mr. Green stated, in reply to several questions, that in some parts of the canal it had been found impracticable to get a sufficient drain to empty the chamber---they were compelled therefore to use a half lock of eighteen-inches fall; that there were seven lifts and one inclined plane on the canal, effecting a rise of 262 feet in eleven miles. That he should not recommend them as applicable to boats of more than twenty or thirty tons. The width of larger boats was an obstacle. They were extremely advantageous for narrow canals; for boats of fifty or sixty feet in length, and about thirty tons.

Mr. Parkes remarked, that he considered the question of narrow canals as a most important one—the advantage to be derived from narrow canals was a subject to which sufficient attention has not been paid.

The President called attention to the remarks in Mr. Green's paper, respecting the quantity of water carried up from one level to another in a downward trade wherever these lifts are to be used; then a coal country on a high level may supply itself with as much water as it sends down coal.

The subject of inclined planes being alluded to, especially those of the Morristown Canal, of 200 feet each, where a rise of 1,600 feet is effected by eight inclined planes, Mr. G. remarked that more water and time must be expended, the friction and length being much greater. In the lifts there was only as much water consumed as was equal to the load, but that he should not consider them as practically applicable to more than sixty or seventy feet. Favorable levels with ascents of more than sixty or seventy feet could seldom be found; could he have had the choice of the line in this particular instance, he should have effected by four lifts the rise for which seven are now employed.

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"Professor Willis, on the Teeth of Wheels."

The geometry of this subject may be considered as complete, but it appears that important additions may be made to its practical applications. The general problem is, having given a tooth of any form, to determine one which shall work correctly with it. The method of effecting this may be shown in a simple practical manner. The curve to be traced out, which is the shape of the required tooth, is the locus of the intersections of all the outlines of the tooth in every one of its positions. The motion produced by the mere contact of the curve so traced out with the given tooth will be uniform. This then is a practical mode of showing the practicability of the problem.

The epicycloids and involutes have hitherto, from the facility with which they can be described, been almost universally employed and practice has been confined to the class of epicycloids which work correctly with straight lines or circles. The defect under which such wheels labor is, that a wheel of fifty teeth of the same pitch will not work correctly with a wheel of one hundred teeth of the same pitch; since the diameter of the describing circle by which the epicycloid is formed, must be made equal to the radius of the pitch circle of the wheel with which the teeth are to work, and will therefore be twice as large in the second case as in the first. Also, if the teeth be epicycloids, generated by a circle whose radius is equal to that of the wheel with which it is to work, which is equally correct, the same remark applies.

This defect was of no great consequence when the teeth were wooden; but is of great consequence in iron wheels, since the founder must have a new pattern of a wheel of forty feet for every combination that it may be required to make of this wheel with others. It is desirable that the teeth of wheels be formed so that any tooth may work correctly with any other of the same pitch. This is the case with involute teeth, but the obliquity of the action is an objection to their introduction. The requisite property may be given to epicycloidal teeth, by employing the following proposition. If there be two pitch circles touching each other, an epicycloidal tooth formed by causing a given describing circle to roll on the exterior circumference of the first, will work correctly with an interior epicycloid formed by causing the same describing circle to roll on the interior circumference of the second.

From this Professor Willis deduces the corollary, that if for a set of wheels of the same pitch, a constant describing circle be taken and employed to trace those portions of the teeth which project beyond each pitch line by rolling on the exterior circumference, and those which lie within it by rolling on its interior circumference, then any two wheels of the set will work correctly together.* This corollary is new, and constitutes the basis of the system already alluded to.

It only remains to settle the diameter of this constant describing circle. The simplest considerations serve to show that the diameter of the constant describing circle must not be greater than the radius of the pitch circle; hence, as a convenient rule, make its diameter equal to the radius of the least pitch circle of the set. This rule is perfctly general, applying to racks and large wheels, as well as annular or internal wheels. The simplicity of this above the old system is obvious, for on the old every epicycloid requires two circular templets; also there must be as many templets as pitch circles in the set, whereas on this system but one describing templet is required.

For machinery in which the wheels move constantly in the same direction, the strength of the teeth may be nearly doubled for the same quantity of material, by disposing it so that the backs are an involute, or the arc of a circle, the acting faces being of the usual form.

In the preceding the exact forms have been described; the author then proceeds to ascertain forms sufficiently accurate for practice, and which

* For there is both before and after passing the line of centres an exterior epicycloid working with an interior epicycloid; for before passing the line of centres, the part of the driving tooth *within* the pitch line works only with the portion *without* the pitch line of its follower: and after passing the pitch line, the part of the driving tooth *without* the pitch line works with some portion of the following tooth which is *within* the pitch line.

are arcs of circles. Euler suggested the substitution of arcs of circles of curvature instead of the curves themselves. The portion of a curve employed in practice is so small that a circular arc is sufficiently accurate provided the centre and radius with which it is struck be determined by some more accurate method than by mere trial. With this view Professor Willis was led to investigate a method in which the nature and properties of curves proper for teeth are entirely neglected, and a simple construction shown by which a pair of centres may be at once assigned for a given pair of wheels, whence arcs may be struck that will answer the purpose of enabling these wheels to work correctly rogether.

The nature of the motion produced by the pressure of one circular are against another, is then examined and reduced to that of a system of three rods, the middle one of which is jointed to two others, moveable at their other extremity about a fixed centre; and a simple construction is arrived at by which we may always find a pair of centres from which two circular arcs may be struck through any point, which will drive each other truly for a small distance on each side of that point. This point, when the side of a tooth consists only of a single arc, should be on the line of centres. It is however more advantageous that the tooth should consist of two arcs, for then there will be two points at which the action is exact—one a little before reaching the line of centres, the other a little after passing it.

From these investigations the author was led to construct an instrument fer setting out the teeth of wheels, which may be used with perfect facility by the workmen, and which has been termed an Odontograph; the application of which is fully described. The paper contains many practical observations connected with this subject, tables, &c., and concludes with some directions for ascertaining the correct form of cutters.

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| | | | |
|---|---|---|---|
| 1835, | boats and | cribs | 10,722 |
| 1836, | do | do | 10,781 |
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## *Errata in the Description of the Long Island Railroad.*

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# AMERICAN RAILROAD JOURNAL,

AND

# MECHANICS' MAGAZINE.

No. 12, Vol. I. New Series. ] DECEMBER 15, 1838. [ Whole No. 324. Vol. VII.

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We respectfully solicit a continuation of these favors from Mr. R.

For the Railroad Journal and Mechanics' Magazine.

## *A Treatise on Reservoir Locks; by* J. A. ROEBLING, *Civil Engineer.*

BY the term Reservoir Locks, is understood Locks connected with Reservoirs which receive and reserve a certain portion of the lockage water for the purpose of floating a vessel from one level to another, and which reserved portion of water is let into the lock-chamber again when another boat is passing the lock. As the reservoirs are alternately drawing and discharging a certain portion of the water, it is obvious that they may be so located as to use a far less quantity of water for passing vessels through the lock than is commonly wanted.

These preceding remarks will be sufficient to attract the attention of Engineers, and lead to the suggestion that this kind of lock is of the greatest importance in a country where the summer season is generally dry, and where the want of a sufficient supply of water for lockage often interferes with navigation; further, that by means of these locks expense will be saved, and that a canal may be constructed, and kept navigable, where in the other case sufficient water could not be furnished for supplying common locks of ordinary lifts. An eminent engineer in England, where this subject is at present treated with much interest, lately claimed to be the inventor of these locks, but without any right. As far as the writer of this is informed, but one lock of the kind in question has ever been constructed until this day. This lock was built in France, under are arcs of circles. Euler suggested the substitution of arcs of circles of curvature instead of the curves themselves. The portion of a curve employed in practice is so small that a circular arc is sufficiently accurate provided the centre and radius with which it is struck be determined by some more accurate method than by mere trial. With this view Professor Willis was led to investigate a method in which the nature and properties of curves proper for teeth are entirely neglected and a simple construction shown by which a pair of centres may be at once assigned for a given pair of wheels, whence arcs may be struck that will answer the purpose of enabling these wheels to work correctly rogether.

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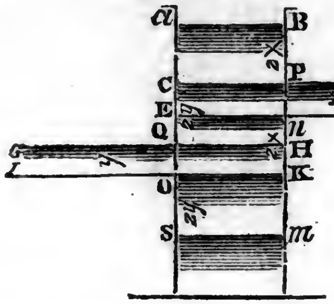
The first locks of this kind, in this country, are now being constructed on the Sandy and Beaver Canal, under the direction of Mr. E. H. Gill, Chief Engineer on that line, who by this improvement will considerably add to the already well-established credit which that work greatly deserves, for the superior construction of its splendid locks and dams, and in fact, for the solidity of all the works. Mr. E. H. Gill occasioned the writer to examine into the nature of this object to establish its theory, and demonstrate formulæ for computing the best dimensions of the reservoirs, the location of the communicating culverts and valves, and the water saved. He afterwards experimented with a model, to see how the theory agreed with the reality, and satisfied himself in every respect as to the practicability and the utility of reservoirs.

As the saving of water depends on the number of reservoirs attached to a lock, their areal extension, and on the placing of the culverts and valves, this matter must be rightly understood, and all dimensions must be fairly calculated, which calculations, however, are very easily performed. I offer here a general demonstration of the theory of this object, which for its plainness will easily be understood.

The number of reservoirs, attached to one lock, may be one, two, three, four, and even more; a greater number than four seldom will be required and found applicable; in most cases two reservoirs will answer the purpose. But there may be locations found where the ground offers sufficient room, and suits well for the construction of four reservoirs, two on each side of the lock, and where by these means a very great saving of water will be obtained.

The annexed drawing, No. 4, shows the cross-section of a lock of fourteen feet lift, with a reservoir of 5,400 superficial square feet, on each side. The Diagrams 1, 2 and 3, are likewise to represent cross-sections of the lock-chamber and reservoirs on each side. By the linear shadings are represented the different stages which the water will alternately occupy in the chamber, and in the reservoirs. The lines A B and S M represent the upper level, and the lower level, in all the Diagrams; and by the lift of the lock, is to be understood the elevation of the upper level A B above the lower level S M. These two levels are supposed to be always permanent, and not to be altered.

DIAGRAM 1.




To make the case more simple, it is supposed that each reservoir is to be as long as the lock-chamber is in the clear, and twice as wide, so that the area of each reservoir be equal to twice the area of the chamber. Let the required height which the water will occupy in the upper reservoir, be denoted by the letter $x$; the height of water in the lower reservoir, be denoted by $y$.

By examining the first Diagram, any one will admit the following suppositions:

1. When the valve of the upper reservoir is opened, a quantity of water A B C P of the chamber will enter the reservoir and will flow in till the water surface in the chamber and reservoir, C P and P D, form one level. Now, suppose this reservoir shut, and the valve of the lower reservoir opened, the quantity of water marked by C P Q H will escape and enter the lower reservoir, till the water surface is sunk to an equal level G Q H. After the lower reservoir is shut, there remains a quantity of water in the chamber, marked by the letters Q H S M, which lies above the lower level, and of course must be drawn off into the lower canal, in order to clear out the boat.

2. Now, take the case reversed; when a boat is to pass from the lower level to the upper level. After the boat has entered the chamber and the lower gates are shut, open the paddle of the lower reservoir, and draw the reserved water into the chamber. All dimensions being right, this quantity of water should exactly fill out the space S M O K, so that the top-water line, O K, and the bottom of the reservoir, I O, be in one level, and no water remains in the reservoir above that level. The boat will now be raised to the level of O K. After the lower reservoir has discharged itself, shut it, and open the paddle of the upper reservoir, and draw off its reserved content of water. This quantity of water should exactly occupy that space in the lock chamber marked by E N O K, so that no water remains in the reservoir above the level of N F, representing the bottom of the upper reservoir. To raise the boat to the level of the upper canal, a quantity of water A B E N is yet required, which must be drawn from the upper level into the chamber, after the valve of the upper reservoir is shut up.

In the first case, that quantity of water which has actually been drawn from the upper level, is marked by the lines S M O H, the quantity of water saved, is marked by A B Q H.

In the second case, the quantity of water actually spent, is marked A B E N; and the quantity saved is marked S M E N. As the area of each reservoir is supposed to be equal to twice the area of the chamber, the space which a certain quantity of water occupies in the chamber will be twice as high, or deep, as the space required for the same quantity of water in one of the reservoirs. Hence it follows, that

$$BP = 2PN = NK = 2x$$

and $$CQ = 2QO = OS = 2y$$

The whole lift A S, or

$$L = AC + CQ + QO + OS$$

or $$L = 2x + 2y + y + 2y = 2x + 5y$$

and likewise is $$L = BP + PN + NK + KM$$

or $$L = 2x + x + 2x + 2y = 5x + 2y$$

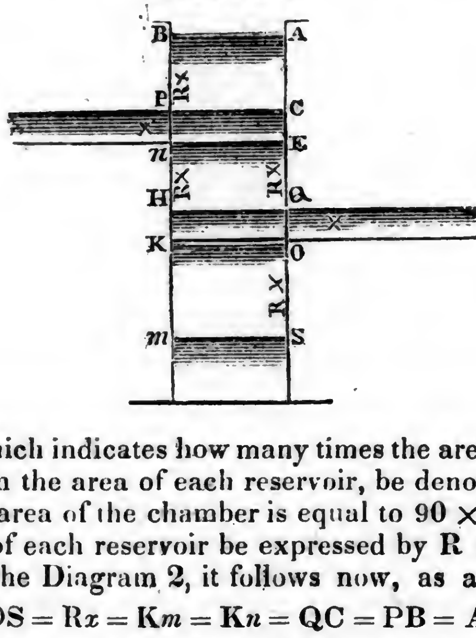
Hence $$2x + 5y = 5x + 2y$$

or $$4y = 3x$$

consequently $$y = x$$

The quantity and stage of water in each reservoir are therefore required to be equal.

Diagram 2.




Let the ratio which indicates how many times the area of the lock-chamber is contained in the area of each reservoir, be denoted by the letter R, so that when the area of the chamber is equal to $90 \times 15 = 1350$ square feet, let the area of each reservoir be expressed by $R \times 1350$ square feet.

By examining the Diagram 2, it follows now, as a matter of course, that $$OS = Rx = Km = Kn = QC = PB = AC$$

By adding the different altitudes, which constitute the lift, we find

$$L = Rx + x + Rx = 3Rx + v = (3R+1)x$$

and therefore, $$x = \frac{L}{3R+1}$$

which expression gives the stage of water in the reservoirs, provided there are two. Without any further examination we can employ the following expressions as formulæ for the other required dimensions.

1. The elevation of the bottom of the lower reservoir above the lower canal level, or $OS = Rx =$ $\frac{R.L}{3R+1}$
2. The elevation of top-water line of the lower reservoir above the lower canal level, QS $(R+1)x =$ $\frac{(R+1).L}{3R+1}$
3. The elevation of the bottom of the upper reservoir above the lower canal level, or $NM = 2Rx =$ $\frac{2R.L}{3R+1}$

4. The water saved, marked by the space MSEN, or BAHQ $= AQ = MN = 2\,Rx = \dfrac{2\,R.\,L}{3\,R+1}$

5. The water used, is marked by MSQH, or ABEN = SQ $= BN = (R+1)x = \dfrac{(R+1)\,L}{3\,R+1}$

By examining the formula No. 4 for the water saved

$$\frac{2\,R\,L}{3\,R+1}$$

we find that the saving increases with the ratio R, though not as fast. When we suppose $R = \infty$, that is, the area of each reservoir to be infinitely great, so that $x$, or the stage of water in each reservoir, will be almost reduced to nothing, the formula will then be

$$\frac{2\,RL}{3\,R+1} = \frac{2\,\infty\,L}{3\infty+1}$$

As the quantity 1 does not increase an infinitely great quantity,

it follows, $\dfrac{2\,\infty\,L}{3\infty+1} = \dfrac{2\,\infty\,L}{3\,\infty} = \dfrac{2\,L}{3} = \dfrac{2}{3}.L$

The greatest saving of water by two reservoirs is therefore equal to two-thirds of the lift of the lock. However, this much can never be gained in reality, though we can come near to it, without extending the reservoirs too much, which would imply other inconveniences, as increase of cost, loss of time, and loss of water by greater evaporation. The foregoing result of the maximum of water saving will become also visible by mere examination of the Diagram, No. 2. We see that when the stage of water in the reservoirs, or $x = PN = QO$, becomes, by being spread over an infinitely great surface, reduced to an infinitely small height, the points P and N, and Q and O, will be brought so near together, that they may be regarded as being reduced to the single points N and O, and therefore is

$$SO = OE = EA = \tfrac{1}{3}\,L$$

and the water saved $= SE$ or $BH = \frac{2}{3}$ L.

---

For a given lift L = 14 feet, and R = 4, or the area of each of the two reservoirs to be equal to 5400 square feet, where the lock-chamber is supposed to be $90 \times 15$ in the clear, we find

$$x = \frac{L}{3\,R+1} = \frac{14}{3\times4+1} = \frac{14}{13} = 1{\cdot}077 \text{ feet}$$

The elevation $OS = Rx = 4\times1{\cdot}077$ = 4·308

The elevation $NM = 2Rx$ = 8616

Water saved, $= 2R.x$ = 8·616

Water used $= (R+1)\,x$ = 5·385

By means of two reservoirs of 5400 square feet area each, a boat may therefore pass a lock of 14 feet lift, and not use more than 5·385 feet water, drawn from the upper level, where formerly, without Reservoirs, a body of water of 14 feet height had to be used.

The following table shows how the quantity of water saved, increases with the area of the reservoirs, supposing two reservoirs attached to the Lock:

For $R = \frac{1}{4}$ the water saved, or $\frac{2\,R.\,L}{3\,R+1} = \frac{2.\,\frac{1}{4}.\,L}{3.\,\frac{1}{4}+1} = 0{\cdot}285\ L$

| | | | | |
|---|---|---|---|---|
| $R = \frac{1}{2}$ | " | " | " | 0·400 L |
| $R = \frac{3}{4}$ | " | " | " | 0·461 L |
| $R = 1$ | " | " | " | 0·500 L |
| $R = 1\frac{1}{2}$ | " | " | " | 0·545 L |
| $R = 2$ | " | " | " | 0·571 L |
| $R = 3$ | " | " | " | 0·600 L |
| $R = 4$ | " | " | " | 0·615 L |
| $R = 5$ | " | " | " | 0·625 L |
| $R = 10$ | " | " | " | 0·644 L |
| $R = 100$ | " | " | " | 0·664 L |
| $R = 1000$ | " | " | " | 0·6664L |
| $R = \infty$ | " | " | " | 0·6666...L |

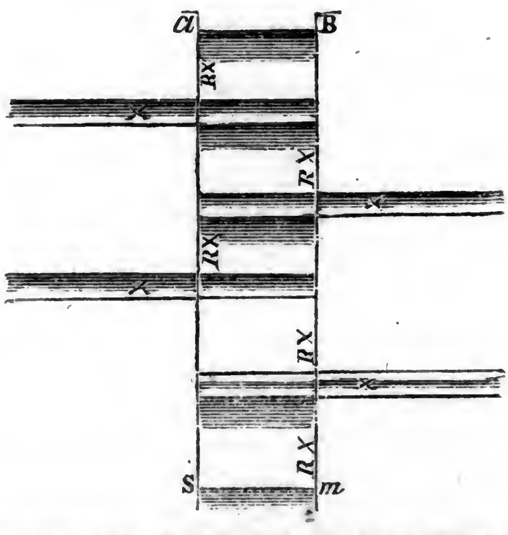
When only one reservoir is attached to the lock, the formulæ for all the required dimensions will be found:

1. The water stage in the reservoir, or $x = \frac{L}{2\,R+1}$
2. The elevation of the bottom of the reservoir above the lower level, is expressed by $Rx = \frac{R.\,L}{2\,R+1}$
3. The height of the water saved is $= Rx = \frac{R.\,L}{2\,R+1}$
4. The height of the water saved is $= (R+1)x = \frac{(R+1).\,L}{2\,R+1}$
5. The maximum of water saved by one reservoir is found

$$= \frac{\infty}{2\,\infty+1} \times L = \frac{\infty}{2\,\infty} \times L = \tfrac{1}{2}\,L$$

By means of one reservoir, therefore, nearly one-half of the lockage water may be saved in reality.

DIAGRAM 3.




When four reservoirs are attached to the lock, as Diagram No. 3 shows, we find the lift

$$L = Rx+x+Rx+Rx+Rx+Rx = (5R+1)x$$ and

1. $x = \dfrac{L}{5\,R+1}$

2. The elevation of the bottom of the lowest or the first reservoir above the lower level $= Rx = \dfrac{R.\,L}{5\,R+1}$

2. The elevation of the bottom of the second reservoir above the lower level $= 2\,Rx = \dfrac{2.\,R\,L}{5\,R+1}$

3. The elevation of the bottom of the third reservoir above the lower level $= 3\,Rx = \dfrac{3.\,R.\,L}{5\,R+1}$

4. The elevation of the bottom of the fourth reservoir above the lower level $= 4\,R.x = \dfrac{4.\,R\,L}{5\,R+1}$

5. The water saved is $= 4\,Rx = \dfrac{4\,R\,L}{5\,R+1}$

6. The water used is $= (R+1)x = \dfrac{(R+1).\,L}{5\,R+1}$

7. The maximum of water saved is represented by

$$\frac{4\,R\,L}{5\,R+1} = \frac{4\,\infty}{5\infty+1}\,L = \frac{4\,\infty}{5\,\infty}\,L = \tfrac{4}{5}\,L$$

This demonstration shows that by means of four reservoirs attached to one lock, nearly four-fifths of the lockage water that is wanted by a common lock, may be saved.

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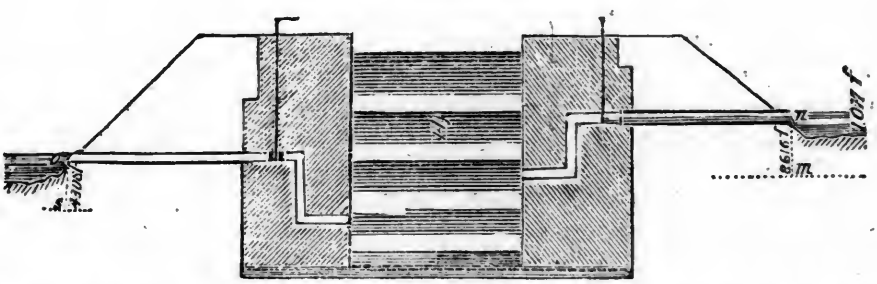

The annexed drawing, No. 4, represents a cross-section of a lock of fourteen feet lift, connected with two reservoirs; each reservoir to have 5400 superficial square feet area. It is immaterial how the bottom of the reservoirs is formed, and it is necessary to have it below the level of the culverts, in order to prevent the dirt from being raised and carried into the lock-chamber. The bottom of each reservoir should be, at least, one foot below the mouth of the culvert, or lower, so that at least one foot of water remains in each reservoir, after the reserved water is discharged. The main object in constructing the culverts is, therefore, to have the points N and O, or the highest point in the bottom of the culverts, so fixed above the lower canal level, that their elevation answers the expressions given by the foregoing formulæ.

The culverts in the lock-wall embankment are represented in the drawing to be of wood. The culverts in the wall itself must be constructed either in the form of rectangular syphons, or straight linear inclined, so that the mouth of the culvert of the lower reservoir opens into the lock-chamber, below the lower canal level; and the culvert of the upper reservoir enters the lock-chamber at an elevation equal to $2Rx$, above the former culvert. The reservoirs may be formed either by excavation or embankment, as the ground suits best. Where the natural ground is pretty level and square to the centre line, and the lock-walls are to be raised about one-half their height above the natural ground at the middle of the lock, it requires but very little excavation and embankment to form the reservoirs. It often occurs that a depression in the ground, or a natural basin, near the lock, can be used to great advantage as a reservoir, requiring nothing but a little more culvert. Where there are two reservoirs, they must be located either, one on each side of the lock, or both on one side, as the ground suits best. In the latter case, the two reservoirs must be separated by a dam, either formed by excavation or embankment. The bottom of the reservoirs, and their side slopes, should be covered with coarse gravel or slaty material, if such material can be had conveniently, in order to keep the water more fresh and clean.

The paddles are best placed in the upper parts of the culverts, as represented in the drawing, in order to prevent a great pressure of the water from the reservoirs towards the lock-chamber, and to keep the water safely shut up. The paddles should fit very close, and move in iron frames.

Whenever the supply of water is plentiful, the boats may pass the locks without using the reservoirs, for saving a little more time. However, the excess of time which is required by using the reservoirs, is very trifling, and the passage can be effected with far less inconvenience and injury to the boats and locks, when the reservoirs are used, than when not. The objections which any engineer has against high lift locks, will be entirely removed by the construction of reservoirs. Reservoir-locks will be found very useful on slack-water navigation, where it is a great object to reduce the number of dams. If in such a case the river-bank on the side of the lock offers no favorable opportunity, and not sufficient room, without removing great obstacles, as solid rock, &c. for the location of the reservoirs, the required width can always be obtained by shifting the lock a little more into the river, and by omitting the lock embankment. A bridge built along the lock wall over the reservoir, will serve for a tow-path in this case. The attendance of a reservoir-lock requires no more skill than a common lock, as the state of water in the reservoirs and the chamber regulates itself, and the lock-keeper has nothing more to observe than to open the paddles, and to shut them as soon as the water level gets settled. When the upper and lower levels are raised in time of a flood, the water will then occupy a different state in the reservoirs, and the contemplated saving of water will not be obtained exactly. In such a case, however, to save water is no great object, and the reservoirs will prove just as useful in all other respects.

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### *Second Report of the Commissioners appointed to consider and recommend a General System of Railways for Ireland.*

We have received this valuable document, and examined it with much pleasure. It contains a great mass of useful professional information, from which we shall draw at times for the benefit of our readers. That part which relates to Atlantic Steam Navigation we give entire, and although written before the success of the experiment was determined, it contains many valuable suggestions for farther examination. We recommend the subject of reefing paddles to the ingenious mechanic, as worthy of experiment.

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### *Inquiry into the Practicability of a Steam Navigation to America.*

Although the experiments for effecting a steam navigation with America are actually in progress, it may be some time before the difficulties and inconveniences that must be experienced at first, will be removed, and it may be, consequently, of some service to offer the few observations which, in compliance with our instructions, we had already drawn up, on the circumstances and principles affecting the practicability of the voyages by steam.

It is a subject which has been discussed with great earnestness, by different parties; and statements, greatly at variance with each other, have been made in support of the one and of the other side of the question.

As it is necessary to have some determinate distance in view, we shall select Cork Harbor as a point of departure; for it may be observed, that if the voyage be practicable from that port, it will be so likewise from Berehaven, Valentia, the mouth of the Shannon, as well as from other Western harbors of Ireland; and on the other hand, the difference in any of these cases is so inconsiderable, with regard to the whole distance, and the facilities for entering and leaving so nearly equal, for steam-vessels, that we can scarcely consider the voyage as practicable from any one of these, and impracticable from Cork; besides, as we have already remarked, that if it be found practicable from Cork, it will be equally so from London, Bristol, or any other English port; because this may always be made the ultimate point of departure, where the vessel may receive her final sea-stores, her coal, the mail, and such passengers as may prefer to join her at that place. Now, the distance from Cork to New-York is about 3000 miles, and two questions present themselves in connexion with this fact, namely: "What is the greatest distance we may consider as falling within the present capabilities of the most powerful and best appointed steamers; and what increased capabilities have we a right to anticipate from the continued progress of that steady course of improvement which has hitherto accomplished so much?"

In the first place, without any reference to improved means, it may be stated as the result both of theory and practice, that the larger the steam-vessel, or the class to which a steam-vessel belongs, the greater (all other things being the same) to her capability for speed and length of voyage.

To look at the question theoretically, it is clear that the means of stowage will be, at least, proportional to the tonnage, which latter will vary as the cube of the dimensions of the vessel, while the resistance will only vary as the immersed section, which is as the square of those dimensions; consequently, if the power of the engines and consumption of fuel, be made proportional to the tonnage, the speed will be greater, and the duration of the voyage in time being the same, the length of the voyage, as regards distance, will be in the same ratio as the speed.

On the other hand, if the power of the engine be only increased proportionally to the resistance, that is, to the immersed section, then the consumption of coal per hour being increased in a less proportion than the means of stowage, it is obvious that with the same velocity as before, the fuel will last longer, and the length of the voyage, both in time and distance, will be proportionally greater.

To illustrate this in numbers, and to show the effects of adopting the one or the other of these means, we will take a vessel of any given tonnage, as for example, 835 tons, and assume her to have a certain medium rate of steaming, say, eight nautical miles per hour, and that her fuel will last her 19 days, the whole length of her voyage being, therefore, 3648 miles, (which are the numbers specifically stated by Captain Anston, of H. M. Steam Sloop, Medea,* as exhibiting the capabilities of that vessel), and let us inquire what would be the capabilities of another, on the same model, of 1670 tons, in point of distance, supposing, first, her power increased proportionally to her tonnage, and secondly, that it is increased proportionally to the resistance, or to the transverse section.

To double the tonnage of a vessel, preserving the same proportions, her linear dimensions must be increased, as 100 to 126, or as 1 to the cube root of 2.

Consequently, her sectional area, or resistance at the same, is as 110 to 158
And her tonnage, stowage, &c., as ........................100 to 200

Now, in the first case, the power being as 200, and the resistance as 158, the increased force per square foot of the section will be as 158 to 200; and the resistance overcome in a given time being as the cube of the velocity, the speed will be increased as in the ratio of the cube root of 158 to the cube root of 200, or as 100 to 108, and the length of the voyage, in regard to distance, will be greater in the same proportion.

In the second case, viz., increasing the power of the engines only in proportion to the sectional, the velocity will remain as in the former vessel; but the proportional consumption of coal will be less in the ratio of 200 to 158, and consequently the length of the voyage in distance will be increased as 158 to 200, or as 100 to 126.

Hence, the capabilities for distance of a vessel of double the tonnage of the Medea, would be, according to the first arrangement, 3,939 miles, and according to the latter, 4,641 miles.

It may not, at first sight, appear obvious, how it happens that so great an increase of distance should arise out of this difference in proportioning the power of the engines, but a little reflection will show that a large proportion of fuel is expended in obtaining the last portion of any acquired velocity. In fact, speed is almost the only quality which has hitherto been considered worthy of attention, in a steam-vessel, the consumption of fuel having been seldom or never regarded. Nothing can be more obvious, however, than that speed can be purchased only at a great cost. The resistance varying as the square of the velocity, to raise the speed, for example, from 8 to 9 miles per hour, requires an increased consumption of fuel in the ratio of 64 to 81, to go the same distance, and of 512 to 729, to steam for the same time; or, which is the same, to increase the speed one-eighth, requires an increased consumption of fuel of one-fourth, which necessarily leads to a great sacrifice in respect of capability of distance.

This result, although sufficiently obvious in a theoretical point of view, seemed to require confirmation by experiment; application was accordingly made to the Admiralty to permit a trial on one of the government steamers, and the result fully confirms the above theoretical deduction.

* See Captain Anston's Report to the Admiralty, Note G.

The only means which presented itself of making the trial experimentally, was by using the steam at a reduced pressure, viz., by reducing the pressure, shown by the steam-gauge from $3\frac{1}{4}$ lb. to 1lb., or the whole pressure, including the atmosphere, from 18 lbs. to $15\frac{3}{4}$ lbs. With this reduction of power, the velocity was reduced only from 8·08 miles per hour to 7·98 miles per hour. The number of strokes was reduced from $2\frac{1}{2}$ to 23, and therefore the effective steam power expended $18 \times 24\frac{1}{2}$ to $15\frac{3}{4} \times 23$, or as 100 : 79, the speed was reduced as 100 to 96 (see Mr. Barlow's Report to the Admiralty, Note F).

It appears, therefore, that in order to allow a vessel to perform the longest voyage with a given consumption of fuel, we must not urge her on all occasions to the utmost of her speed, and there can be no doubt, that as soon as the question becomes, "How to go the farthest," the ingenuity of our engineers will be as successfully employed in increasing the capabilities of a vessel for distance, as it has hitherto been in increasing it for speed.

Of course, the means of reducing the power above spoken of, viz., by reducing the steam pressure, is not supposed to be the best way of effecting the object; it was had recourse to in the experiments as the only one which readily presented itself; the same purpose would probably be effected in practice, by using the steam more or less expansively; and we learn that this is proposed to be done by a peculiar construction, both in the engines of the British Queen, building for the British and American Steam Navigation Company, and by Messrs. Maudsley and Co., who are now making those for the Great Western.

There is also every reason to expect that much will be effected in point of increased speed at the commencement of a long voyage, and during the voyage, without incurring an additional expense of fuel, by the invention of some ready means of reefing the paddles. At present, taking the most powerful of the government steam-vessels, as for example the Phœnix—her immersion, with a full cargo of coal and sea-stores, is between three and four feet more than at the end of the voyage, when all are expended. Her paddle-boards are, therefore, wholly immersed and smothered at the beginning of the voyage, in order that they may be at all efficient at the end of it. The consequence is, that an immense amount of power is expended, besides all the heavy shocks which the engine sustains, by the boards at the most unfavorable angle.

Now, if means should be devised of remedying this evil by a ready method of reefing the paddles, there can be no doubt that at the commencement of a long voyage, the boards would be brought up two or three feet nearer the axle of the wheel, and be gradually expanded as the vessel becomes lightened; and on other occasions, of favorable weather, as much skill would be exercised in managing the paddles, as is now employed on the sails and rudder, all which would tend to increase the capabilities of a vessel for the performance of a long voyage.

We are aware that certain forms of paddle-wheels have been used, with a view to preventing the shocks the engine sustains in the cases to which we have alluded; but those consist of a number of moving parts, liable to derangement and accident, and difficult to repair, which seem to render them unfit for a long voyage. There are also other propositions for altering the form of the wheel, viz., by replacing the persent whole paddle board, by two or three more new boards, set in certain steps, to meet the water at the most favorable angle, under the medium state of the vessel, and experiments are at this time being made at Woolwich, by order of the admiralty, to ascertain the advantages of this proposition. We are however of opinion, that the great difference in the state of the vessel between her starting and the completion of a long voyage, requires that her paddles, whatever may be their form, should be adjustable according to circumstances, not only of the lading of the vessel, but of wind and weather.

It appears also by recent experiments made by order of the admiralty, that great as are the improvements which have been made in the different parts of marine engines, and in the construction and appointments of the vessels, there still remains much to be effected, particularly in properly proportioning the size of the paddle boards to the power of the engine. From the experiments alluded to, it has been found that by gradually reducing the area of the paddle board from 12¼ feet to less than 8 feet, the speed of the vessel (the African) was at every step increased, and that it was only when the board was reduced to little more than six feet that the speed began to decline; and even then, it was greater than with the board of 12¼ feet. This result is certainly extraordinary, but it is not less true and important—while it shows how much still remains to be effected, and how much we have reason to hope for from the exertions and ingenuity of our engineers.

It may be observed, that the admiralty, acting on the facts thus elicited, has ordered the African to be furnished with paddles, consisting of two boards each, the whole of which is only 6 feet 10½ inches; whereas the whole paddle was 12 feet 3 inches.

The Rhadamanthus has also had her paddles reduced one-fourth.

There can be no doubt, therefore, that the paddle boards hitherto employed have been generally much larger than is required, and that vessels have been unnecessarily shaken and the engines strained in consequence, for it appears that this kind of motion is no less remarkable than the observed increase of speed.

We may remark that the experiments above alluded to, on the African, were made on the River Thames, and many persons, in consequence, felt great doubt as to the effect of such small paddles at sea. It is therefore satisfactory to us to be able to state, on the authority of a letter from Captain Beechy, R.N., who has now had several months experience, that the boards have proved equally effective at sea. On one occasion a trial was made by adding a third paddle to each radical bar, and the result was a considerable imminution of speed.

Improvements are likewise in progress, in respect to the form of condensers, and in many other matters relating both to the vessel, and the Engine.

There are also other considerations to be attended to; the flues of the boilers will require cleansing; although from some facts that have come to our knowledge, this is not so frequently necessary as has been supposed. We have instances of a vessel steaming for eleven days, without cleansing her flues, and with but little diminution of draught; and it will be seen by referring to the very valuable remarks of Captain Austin, (note G.) that this operation is not essentially necessary more than once in seven days, or perhaps even during the voyage to America. And we understand it was proposeed by Messrs. Maudsley & Co., to form the boilers of the Great Western in four distinct parts, at eighteen inches from each other, which will allow of any one being thrown out of work—to be emptied, filled with cold water, and cooled down so as to admit of its being cleaned without its interfering with the working of the engine, a time being, of course, selected for this operation, when the vessel shall require the least assistance from steam power. The same principle will also be followed in the boilers of the British Queen.

Weighing all these circumstances, and relying on the immense resources of mechanical skill which this country possesses, we can entertain no doubt that means will be speedily devised, of economising the consumption of fuel, and of making the best use of that which is expended, so as to give to steam vessels a greater capability than is necessary for crossing the Atlantic, and that a voyage from Ireland, as the point of departure for America, is already fully within the powers of steam navigation to effect.

We have hitherto spoken of a vessel, as a steamer only, but it is to be presumed that she will gain much by the power of her sails. It appears that the steaming powers of a vessel are by no means incompatible with possessing good sailing qualities. Referring again to Captain Austin's report, it will be seen that the sailing rate of the Medea, when on a wind, in a strong, single reefed topsail breeze, in smooth water, is 8 knots per hour, and in a moderate quarterly gale, 11½ knots; and that her tacking may be depended upon in strong breezes, in sea, fully equal to a sailing vessel of war in light winds, when she has steerage way. Again, it is stated that in treble reefed topsail breezes, while cruising with the squadron, we have found to wear considerably upon them, showing the advantage of the great quantity spread in the fore and aft sails. *(See note G.)*

There is therefore every reason to expect, even in an outward voyage, that a vessel properly constructed and rigged, will benefit greatly by her sails; and it is of the utmost importance that she should, in such case, save her fuel, or use it in the most economical manner.

In the Medea there is an easy mode of disconnecting the wheels from the engine, and under the most favorable circumstances the former are let to run loose, and the engines stopped; but Captain Austin would prefer, if it were always practicable, to reef the lower boards, or to remove them. He also recommends on other occasions, for the sake of economy, to employ one engine and set of boilers, with their fires, &c.; and a similar proceeding was adopted by the Captain of her Majesty's Steam-ship Phœnix, when he found that three-fourth speed was obtained with one half the fuel; but the means provided in the engines to which we have referred, will effect the objects here contemplated, much more conveniently, by using the steam more or less expansively, as circumstances may require; and by a judicious application of these means, no doubt great economy and great advantage will be obtained.

Being desirous of obtaining all the practical information within our reach, on this important question, we have called for and been supplied with a report from Lieutenant Davis, R. N., commanding H. M. Steam-packet Gleaner, who has been accustomed to steam navigation for eighteen years. This report relates to many points which do not properly belong to our inquiry, but in that part which relates to the capability of a steam vessel to cross the Atlantic, we find that it agrees with the reports of Captain Austin, Captain Oliver, and others, in enforcing the condition of his urging the vessel to her greatest speed; of economizing the consumption of fuel when the sails are available, and of saving the fuel altogether, under strong adverse circumstances. We may remark, indeed, that Lieutenant Davis recommends the application of a lower amount of of steam-power than we have found to be the general opinion, but this is only a difference in degree, not in principle. Of the capability of a vessel to perform the voyage, no doubt is entertained by any of the above experienced officers, provided only that the commander be a man of judgment, and one well acquainted, by practical experience, with steam navigation. There will be, undoubtedly, considerable difference in the time, between the outward and homeward voyages; but without the light which experience can throw on the question, it would be impossible to compute with accuracy what the amount of that difference may be. At present, with the sailing packets of the first class, between Liverpool and New York, the average time outward is 36 days, and homeward 29 days. It will, of course, be much closer, when steam is employed.

In order to form a probable estimate by comparison, we have ascertained that the mean time of our Mediterranean packets and Cape Finisterre is 74·4 hours, and from Cape Finisterre to Falmouth, 62·2 hours. The former, being the mean of sixteen passages, and the latter for twenty passages. We have also obtained a return of H. M. Steam-packets to and from Liverpool and Kingstown, for the first six months, from January to June, 1837, both included, and it will be seen, by referring to Note I, that the difference of time is only 30 minutes; the mean time being 13 hours 15 minutes; and the mean speed, for the whole time, nine nautical miles per hour. Now, as the difference of these times, in both cases, is due to the prevalence of Westerly winds, and as it is to the same cause we must attribute the anticipated difference in the passage to and from Ireland and New York, we are perhaps justified in assuming, that the powerful steamers, such as the British Queen and Great Western, will perform their return voyage in 14 or 15 days, and their outward passage in 16 or 18 days

We therefore repeat our firm, deliberate opinion, the result of most careful and anxious inquiries, that a transatlantic navigation by steam, between Great Britain and America, is practicable, and that Cork is, at present, the most available Irish departure.

*Note F.—Experiments on Steam Vessels.*

Letter from Mr. Barlow, to Sir John Barrow, Bart.

*Woolwich*, 7th November, 1836.

Sir:—I beg to inform you, that agreeable to the permission given me by my Lords Commissioners, I this day, with Mr. Ewart, made the experiment suggested in my former letter, on the Echo steamer; there being on board 48 tons of coals, and stores for channel service.

We found the pressure of steam in the boilers by the steam gauge, 4 pounds per inch, and by the usual trial ascertained the main speed, per hour, to 8·42 miles

The steam was thin, as suggested by me, and reduced to 1½ pounds per square inch, as shown by the same gauge, and the mean speed, found as before, was 8·46 miles per hour.

The result is certainly extraordinary. I anticipated a reduction of speed, but less in proportion than the reduction of fuel. We found, however, no change of speed, or if any, in favor of the reduction of fuel. Every thing was satisfactorily conducted. The time was taken by two persons independently, and Mr. Ewart attended to the steam gauge and management of the fire.

Although we could not tell the exact difference in the quantity of fuel consumed in the two cases, it was obviously much less, as indeed it ought to be, seeing that the quantity of steam used was nearly 26 per cent. less.

The experiment is therefore well deserving of attention, and as it may be repeated with only about an hour and a half additional time, whenever the usual experiments on the speed of the vessels are made. I have reason to hope that their Lordships will give directions to that effect; and I shall in that case feel myself much obliged by being furnished with the results.

I have the honor to be, Sir, your obedient servant,

[Signed] PETER BARROW.

Copy of a letter from Mr. Barlow to Charles Wood, Esq., M. P.

WOOLWICH, 2d March, 1837.

SIR:—In compliance with the request of Sir Charles Adam, I beg to forward to you a concise abstract of my experiments on H. M steamers Echo and Lightning, and the conclusion I draw from them, although perhaps, they require to be confirmed by one or two other experiments.

It is well known that the resistance of water to a body moving in it, increases much more rapidly than the proportion of the velocity, and therefore that the quantity of fuel requisite to increase the speed to any given velocity, as for example, from 9 miles to 9¼ miles, would be much greater than in the latter proportion; in fact, that by being content with the former speed, the same fuel would, in some cases, carry the vessel 100 or 200 miles further than with the latter.

This was my theoretical view of the subject, and by permission of the Lords Commissioners, I put it to the test of experiment in the two vessels above named, and the result was, that by reducing the power, and therefore the expenditure of fuel one-sixth, the speed was reduced only one twenty-fourth; and this result is in a great measure confirmed by the prior experiments of Captain Oliver, on H. M. steamer Dee.

I consider, therefore, that it would be desirable that the Captains in command of H. M. steam-vessels should be made acquainted with the fact, and that they should be recommended, when their vessels are employed on services which do not require the greatest speed, (at all cost) and when wind and weather are favourable, to work with their steam gauge at not more than one pound above the atmosphere. This may be done by allowing their fires to act with less energy, without requiring any other change, and the full power will be always at command, if any circumstance should require it.

There can, I think, be no doubt, that this practice, in such cases as I have supposed, would allow the same distance to be run at 9 miles per hour, with one-eight fuel than if the speed were forced all the voyage to 9¾ or 9½ miles per hour.

I have the honor to be, Sir, your obedient servant,

PETER BARLOW.

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*Pin-making.—Triumph of Machinery.*—At Messrs. D. F. Taylor and Co.'s patent solid-headed pin manufactory, near Stroud, the machinery simultaneously performs the various functions, with little noise or effort while converting the rings of wire into pins, without the instrumentality of any manual assistance whatever; for while one combination of the machine is drawing forward, and straightening the wire, and cutting it to the required length, another apparatus is forming and smoothing the point, a third compressing and shaping the head, and a fourth detaching and drawing out the pin in its finished state, which falls into a receiver prepared for it; thus forty-five pins per minute are made by machines, while the whole plant is producing the almost incredible number of three millions two hundred thousand pins daily, exceeding nineteen millions weekly throughout the year.—*Mining Jour.*

*New Material to be applied to Dwelling Houses, to render them capable of resisting Fire.*

About the middle of November, 1837, the scientific world was some what startled by observing, in the newspapers, an announcement that a discovery had been made and perfected, of a material to be applied to dwelling-houses, capable of entirely resisting the action of fire; that an experiment was to be made to prove its efficacy, at White Conduit House, Nov. 25, 1837; and that the presence of all parties concerned was requested to view the exhibition. It might have been supposed that the answer to this appeal would have been universal; and, as parties generally attend where there is nothing to pay, and they really are interested, that half London would have been present on the occasion. But, unfortunately, John Bull has had "Wolf!" shouted to him so often of late, mighty discoveries have turned out "such fantastic tricks," that he as grown very sceptical indeed. There was, however, a tolerably numerous party collected at White Conduit House on the day of experiment; some, of course, interested in its success; others, perhaps, equally so in its downfall. The material is, in appearance, a cement, and, like it, may be applied with the trowel, or with a brush in the manner of paint. Mr. Dewitte, the inventor of this composition, considers that it should be applied to the timber of a house while building, about a quarter of an inch thick; or it may be employed instead of the common plaster now in use, as it can be worked with equal facilty, and polished and painted the same. Sufficent quantity has not yet been prepared to form any certain estimate of the expense; but he considers that the cost of preparing the whole of the timbers of an 8 or 10 roomed house would not exceed 30*l*. or 40*l*. For the experiment, two little wooden houses had been constructed; the one prepared interiorly, with the exterior just washed over to show the nature of the composition, and the other left in its natural state. These were filled with shavings and fired: the one not prepared was, of course, immediately one mass of flame, while the other resisted every effort to ignite it. It was delightful, at this moment, to watch the disappointment of the oppositionists, who afterwards took an unfair advantage of a neglect on the part of the proprietors. When the burning mass of the unprepared house was at its greatest heat, they busied themselves to turn it round close upon the other building, through Mr. Dewitte assured them that the exterior of the building was not prepared. After some time it began to burn, and they gloried in their triumph, until the one building, having burnt itself out, dropped to the ground, and discovered the side of the other partially burnt away, but with the inside coating and the rest of the buildnig as perfect and unharmed as if it had never been touched, notwithstanding the furnace heat that had been applied to both sides of it. The persons assembled, among whom were Mr. Barry, and other eminent architects and scientific people, declared themselves perfectly satisfied of the complete success of the material: the only hope expressed was to see the experiment tried on a larger scale, when the proprietors shall be better prepared for it. Convinced of its perfect efficacy and value. I trust they will immediately set about preparing a more extensive trial, to prove to those who are so anxious to throw cold water on the invention, that it is of no more use in stopping their progress, than it would be in stopping the progress of the flames when we shall enjoy the security of having our houses prepared with their composition.—*A. December*, 1837. Arch Mag.

*First Russian Railroad from St. Petersburg to Zarskoe-Selo and Pawlowsk, established by imperial decree of 21st March, 1836, and carried into execution by a company of shareholders in Russia, England and Germany. Translated from the German.*

Continued from page 355.

*The works* executed on the whole line in the course of last year are detailed in the Chevalier's Third Report as follows:—

*The Drainage* of the lands on each side of the railway embankment was effected the first thing in the spring, by intersecting them with trenches, which was the more necessary as a great part of the railway runs on a mossy soil, the drainage of which, and particularly that part where it passes through the bog of Schuschars, had been commenced at a great expense in the reign of the Emperor Alexander, but not completed. By this trenching, which cost nearly 30,000 rubles, the grounds to the right and left of the line were drained and materially improved. The railway, as it was projected by the Chevalier, lies wholly *on an Embankment*, the average height of which is $10\frac{1}{2}$ feet, or 14 feet of earthwork, if the depth of the trenches ($2\frac{1}{2}$ feet) be included. This height was adopted to facilitate the sweeping off of the snow by the wind, an object much assisted by the forests having been cleared for a breadth of 420 feet, and by the straight line of the railway. In Russia every turnpike road passing through a forest has a clearing of 210 feet on each side, and the same privilege was granted to the company for this railroad.

The embankment contains 77,000 cubic fathoms, of which 61,376 cubic fathoms, or 779,703 cubic yards, were finished last year; therefore about 16,000 cubic fathoms remain still to be raised. As this work was not commenced until the 9th May, and continued only until the end of September, it being the custom of the labourers to leave off work in the early part of October, in order to return to their homes, to which many have to travel hundreds of miles on foot, it follows that the remainder can be completed within the first two months of the thaw in the spring of 1837. There is the less doubt of this, as the greatest confidence has been created in the contractors and labourers, by the pecuniary arrangements adopted by the Directors. All the payments were made weekly on the spot, in the presence of the workmen, and every account was made up immediately work was over. This will naturally induce numbers to return in the spring, and speedily finish the remainder of the line.

*The Bridges* are built of wood, as is customary in Russia; only the one over the outer canal, on account of its large spans, has stone piers. Thirty-four wooden bridges were finished last year, and the piling for five more completed. At the bridge over the canal, 23 cubic fathoms of masonry remain unfinished; two smaller wooden bridges have not been begun, but all the forty-two bridges will certainly be finished early in the spring.

The embankment will be covered by a bed of stone *rubbish and ballast*, 7 feet wide and 15 inches deep, on which are placed the *cross pieces*, or *timber sills*, $10\frac{1}{2}$ feet in length, and 14 inches wide, to which the pedestals and rails are fixed by pins. The difficulty of conveying ballast by waggons to a line, mostly through a boggy country, prevented a sufficient supply being run on the embankment last year; the delivery is therefore now taking place by the sledge road.

Of the *Sleepers*, above one-third has been already delivered, and the rest of the supply is now in course of delivery by sledge.

*Rails are laid down* from the terminus of the line at Pawlowsk to Zarskoe-Selo and Kusmino, 7½ wersts, and in three other places rather more than ½ werst—in all, therefore, 7 English miles. By the end of July, 1837, at furthest, the laying down of the remaining distance, 11½ miles, will be finished.

*The Vauxhall building* at the end of the railroad, has been constructed almost in the centre of the magnificent park of Pawlowsk. It is known that this park is three miles and a half in length, and nearly two and a half miles in breadth, and that, in point of situation, it may be considered one of the finest in Europe. The company's building there is intended to receive the St. Petersburg public visiting the Park; it has a frontage of 350 feet, contains six saloons, two conservatories, forty apartments to be let to the public, and twelve rooms for the hotel keeper and his servants. A steam engine of eight horses' power forces the water into a cistern at the top of the house, whence it is conducted, properly filtered, by pipes to the different parts of the building, supplying also a fountain in the grand saloon, and two other fountains outside. A gallery 32 fathoms in length leads from the railway to the building, so that travellers, arriving in rainy or snowy weather, may walk into the house dry. The building of this colossal edifice, which has a stone foundation, but is otherwise built of wood, was not commenced until the 7th July, but made so rapid a progress, that before the end of September the roof of plate iron was already laid. During the whole of the winter the work in the interior was carried on, and fires were kept up daily to dry the walls; early in the spring the stucco and other work will be begun, so as to fit this building for use at the opening of the whole line in July, 1837.

At the *Zarskoe-Selo station*, two well aired sheds, each 105 feet in length, have been erected, the one for three locomotive engines, and the other for sixteen railway coaches; here also one of the English weighing machines has been put up. The stone foundation of the station and hotel, 300 feet in length, was finished in the autumn, and the upper wood work proceeded with during the winter; it will be finished in the summer of 1837, without fail.

The erection of *the Terminus in St. Petersburg*, consisting merely of spacious premises for the reception of passengers, sheds or locomotives and railway carriages, work shops and dwellings for the officers, is now commenced, and will be completed this summer.

On each station a high tower of stone and brick will be erected, and on each of them will be placed one of the London turret clocks, the four transparent dials of which will be illuminated from the inside at night. The stations will also be lighted by reflectors.

The railway within the town of St. Petersburg will be *double and treble railed*, but for the remaining distance will have only *a single line*, provided with numerous sidings; the ground has been at once taken for a double track. As the railway outside the town, for sixteen English miles, forms a straight line, and as the English clocks at St. Petersburg, Zarskoe-Selo and Pawlowsk will correspond, a single line of rails will for the present suffice. On an increase of traffic a second line can immediately be added.

As was before observed, the imperial grant was signed the 21st March, 1836, whereupon the Chevalier von Gerstner set out directly for England, to order the rails, locomotives, carriages, &c. &c.; on the 9th May the embankment was begun; on the 27th July the first English vessel with rails arrived at Cronstadt, and on the 27th September a distance of 3½ wersts of the railway, from Zarskoe-Selo to Pawlowsk, was opened.

The locomotives not having arrived, horse power was made uee of. On the 3rd November the opening of the railway by the first locomotive ensued; since which the distance between Pawlowsk and Kusmino, about 4¾ miles, has been periodically traversed during the whole winter, on which occasions the concourse of people was very great.

The locomotives performed their duty in the most satisfactory manner, for they were driven whilst the thermometer shewed 18° cold by Reaumur, (8·5° by Fahrenheit) in high winds and rain, and on the 4th January, during a terrible snow storm. Besides passengers, the trains have conveyed horses, sheep, pigs, large timber, wood for fuel, and every description of equipage, placed on their respective lurries and platforms. Hitherto, no obstruction of any kind has occurred, nor has a single rail broken. Every one was convinced of the security afforded by the gage that had been adopted, and how much it contributed to the ease of the traveller; for although the road had been only just made, and consequently the embankment could not have settled much, the motion of the carriages was so gentle, that those who had visited the English railways, which had been opened for years, expressed their surprise, and highly approved the introduction of the wider gage.

The anxiety of the public to attend the railway excursions was so great, that, for instance, on the 24th January, there were 1833 passengers, although every one, in order to join in them, had first to come from St. Pétersburg to Pawlowsk, 19 miles, and pay 18s. to a guinea for a sledge. A very favorable result may be calculated upon so soon as the line is carried into the capital.

Each locomotive has six wheels, of which the middle or driving wheels are six feet in diameter; the weight of a locomotive is 270 cwt. English, and of an empty tender 93 cwt.; an empty half open carriage with 24 seats, weighs 78 cwt.; an empty coach with 30 seats, 68 cwt., an open waggon with 40 seats, 47 cwt. The whole weight of a train with 350 passengers, is about 1600 cwt.

To each locomotive, two *plough shares* are attached *for clearing away the snow*, and two *brushes* before the first pair of wheels, and four others between the next to sweep the snow clean off from the rails; but as the snow in Russia is finer, and more in the nature of sand than that of other countries, it does not ball; the snow apparatus has, therefore, hitherto not been made use of, as the snow has invariably been swept clean off the embankment by the wind, which generally blows strong in the neighbourhood of St. Petersburg.

In the park of Pawlowsk alone, where the trees have been felled only to the width of four fathoms, and near the station at Zarskoe-Selo where the line is sheltered from the current of air by the building, the snow was cleared away by labourers, but the expense thereby incurred from the commencement of the winter, did not quite amount to 300 rubles banco, about £12.

After the Chevalier von Gerstner, in his Third Report, positively insures the opening of the whole railroad from the station on the Fontanka to Pawlowsk, between the 15th July and 15th August, he adds, with reference to his management—

"Whoever will bear in mind that the Imperial Decree was dated on the 21st March, 1836—that until then I could not take my departure for Belgium and England, for the purpose of giving the orders in those countries for the railway materials—that these orders came when the English manufactories and iron works were occupied night and day, to the utmost stretch of their capabilities; whoever will bear in mind that the gage of the English railways is 56½ inches, whist ours is 72 inches, and therefore that not a locomotive, not a carriage or a turntable could be purchased and imported that had not to be planned and have new models expressly made for it, after which, and not until then, the various machinery could be put in hand and made; whoever will further consider that every rail and piece of machinery, when finished, had to be conveyed to some sea-port town, there to be shipped for Cronstadt; on its arrival there, to be transhipped into lighters, to be brought on the Fontanka canal to St. Petersburg, again unloaded, and, frequently on the worst of cross roads and marshes, carried to the point of their destination on the railway, there to be laid down and adjusted or fitted up; whoever will calmly examine and weigh all these matters, will not withhold from the Direction of the railway of which I have the honor to be a member, the testimony that nothing but the greatest ardour and spirit, systematic management and punctuality, especially in the payments, could, in so short a time, have brought about a result which, in other countries, it generally takes years to achieve.

"As by the arrangement which the directors concluded with me in the name and on behalf of the Company, and by virtue of section ten of the Imperial Ordonnance, the works were committed to my management under certain conditions, involving great responsibility, I lost no time in applying all my energies to the promotion of this great undertaking.

"Although I personally directed the works along the entire line, and traversed it continually on foot from St. Petersburgh to Pawlowsk and back again, I nevertheless thought it right to employ seventeen engineers, five of whom had visited the railways in England, as superintendents; besides these, upwards of thirty inspectors, and as many watchmen and soldiers were periodically present on the line. For erecting the machinery and as enginemen for the locomotives, ten Englishmen and two Belgians came over—of the former five have returned.

"Solidity of materials and accuracy of workmanship,—strict integrity in all money transactions,—the greatest publicity in the accounts,—indefatigable attention to the progress of the undertaking,—system and order in the management, were the points I kept in view from the moment in which I commenced this enterprize. By the observance of them I have brought the work, so far as regards my own department, to its present state; by similar conduct I shall bring it to an honorable issue. Russians, Germans, Englishmen, Italians and Belgians co-operated in our undertaking, and a stranger might not unreasonably have been astonished when, on the point of the line, at the building at Pawlowsk he heard five languages spoken and found the people of five different nations here, at so distant a point of Europe, united for one purpose—the promotion of our great object.

"I consider it my duty to state, and do so with pleasure, that the Russian population, so far from throwing obstacles in our way, have invariably been anxious to assist in the execution of the work.

"Incredible as it may appear to my foreign readers, I can state as a fact that no opposition has been evinced (as has almost invariably been the case in other countries) to so great an innovation. The proof is easily adduced, for not a single complaint of premeditated obstruction has come before the authorities. Our difficulties hitherto have been confined to the negociations with the proprietors of the plot of ground between the Ligofka and Fontanka, being town lands; without the town the farmers freely ceded their lands: on the first intimation being given to them by the surveyors, they cleared their forests to the width of 60 fathoms—nay, they mowed the half ripe corn in their fields, in confident reliance that the compensation the law has awarded them would be duly paid. The peasantry from the whole surrounding country worked on the line; and they were the first, who upon its opening crowded into our railway office, there paid their 40 kopeks for a seat, and availed themselves of the new conveyance. The coachmen and innkeepers at Zarskoe-Selo and Pawlowsk, immediately perceived the prospect of gain which was opened to them; the former arguing the increase of their business in the conveyance of such a number of persons to the stations, and the latter that they will have to accommodate crowds of visitors whom the Campany's buildings will be insufficient to contain."

The total disbursements of the whole enterprize, out of the capital paid in, are—

| Year 1836. | Disbursements in Russia. | | Remittances abroad. | | Total. | |
|---|---|---|---|---|---|---|
| | Rub. | Kop. | Rub. | Kop. | Rub. | Kop. |
| April | 130,000 | — | 45,443 | 77 | 175,443 | 77 |
| May | 51,748 | 20 | 297,971 | 77 | 349,719 | 97 |
| June | 120.529 | 18 | 22,423 | 31 | 142.952 | 49 |
| July | 218,485 | 09 | 503,043 | 82 | 721,528 | 91 |
| August | 183,813 | 26 | 44,716 | 26 | 228.529 | 52 |
| September | 249.120 | 63 | 1,200 | — | 250.320 | 63 |
| October | 222.366 | 09 | 191,121 | 21 | 413,487 | 30 |
| November | 116,791 | 17 | —— | — | 116,791 | 17 |
| December | 53,393 | 39 | —— | — | 63,393 | 39 |
| Total Payment in 1836 | 1,356,247 | 01 | 1,105,920 | 14 | 2,462,167 | 15 |
| From 1 to 25 Jan. 1837 about | 40,000 | — | —— | — | 40,000 | — |
| Totals | 1,396,247 | 01 | 1,105,920 | 14 | 2,502,167 | 15 |

The *number of share-holders* in the railway is, according to the company's lists, in the Governments of—

| | | | | | |
|---|---|---|---|---|---|
| St. Petersburg | 372 | Pskoff | 8 | Kieff | 1 |
| Moscow | 186 | Saratoff | 4 | Courland | 1 |
| Wiatka | 19 | Livonia | 4 | Smolensk | 1 |
| Tula | 16 | Kasan | 3 | Wladimir | 1 |
| Twer | 11 | Novgorod | 2 | Woronesch | 1 |
| Astracan | 10 | Esthland | 1 | | |

together in the Russian Empire.............. 641 shareholders
In Germany and England..................... 59 "

We now come to the proper *object* of the Zarskoe-Selo railroad, its probable *traffic*, and the *profit* the shareholders are likely to derive from it. Upon this subject the Chevalier von Gerstner thus speaks, in his Memoir of 20th March, 1836, in consequence of which the company was formed:

"St. Petersburg, the modern capital of the Russian empire, was founded by Peter the Great in 1703, at the entrance of the Neva into the Gulf of Finland, in a low, and formerly quite a marshy country. However advantageous this site may be for trade, it has been attended with incalculable disadvantages; amongst which may be reckoned the periodical inundations, of which the 7th November, 1824, afforded so dreadful an example; the changeable state of the weather and temperature, the fogs which envelope the town, the difficulty of constructing sewers for carrying off the impurities from the streets, and of laying down pipes for spring water. The canals which intersect the town are no doubt of importance for the conveyance of fuel and building materials to the town; but they likewise serve as receptacles for filth, and in the heat of summer fill the air with offensive effluvia. The sewers of the principal streets, for want of sufficient fall are at intervals obliged to be opened, and the contents laid in the streets and carted away. The consequence is, that the exhalations, especially in warm weather, are very unwholesome, and hence the urgent necessity that the inhabitants of St. Petersburg should, at that season, leave town to reside in the country."

Hitherto the country houses have been confined to the adjacent islands, elevated only a few feet above the Neva, and in spring and autumn, therefore, covered with fogs. These islands, nevertheless, were generally filled with temporary residents, and country houses continued to spring up in the immediate vicinity of Petersburg. The cheerful town of Zarskoe-Selo is 16 English miles from St. Petersburg, situated on an eminence bordered by the Neva. The imperial palace there is 220 feet higher than the Neva; the town of Pawlowsk, 2¼ English miles further, lies 105 above the Neva. The charming situation of these two places, and of the imperial parks adjoining, are sufficiently acknowledged and admired; but owing to the distance from the capital, not above 300 families could annually reside there in summer. Notwithstanding the distance, however, both were much frequented on Sundays.

For a conveyance to Zarskoe or Pawlowsk, 18s. to 22s. sterling is paid; for a place in the stage coach 3½ rubles, and as much back; nevertheless from enquiries instituted by government in 1834, the number of equipages passing from St. Petersburg to Zarskoe-Selo and Pawlowsk, and back again, for one year. was 70,386. employing 178,187 horses. At the rate of one passenger for each horse, the present annual transit of persons would thus be 178,187, of whom half or 89,093 make the journey there and as many back. This great traffic may be attributed to the delightful situations of the towns, as well as to the circumsatnce that in Zarskoe-Selo and Pawlowsk 5 regiments, with 300 officers, are stationed, including the two depot regiments, one of infantry, and one of cavalry, the officers of which change every year or two, as they only learn the routine of duty here, and then return to their stations in the interior of the empire; the traffic therefore on the part of the officers is the same, winter and summer.

From the perfect construction of this railway, 16 miles of the line being straight, with a medium rise of 1 in 1028 the whole journey to Zarskoe-Selo will be performed in thirty five minutes, and to Pawlowsk in forty minutes. Both places will therefore be converted into suburbs of St. Petersburg, as the time alone fixes the distance. If a passenger is forwarded by the railway for about 1½ rubles, there can be no doubt that as the line runs 1½ miles from the Ligofka to the Fontanka Canal in the interior of the town, a great traffic may be calculated upon.

To be continued.

*Louisville, Cincinnati and Charleston Rail Road.*

The following letters were among the documents submitted by the Governor with his message, to the State Legislature of South Carolina.

Charleston, Nov. 24, 1838.

Dear Sir—I am addressing you a further reply to your enquiry as to the probable nett revenue of the road, which I will send you by to-morrow's mail—meanwhile, I am just reminded, that in all my answers to you, I have calculated from Columbia to the *summit of the Blue Ridge for the North Carolina Line*—which lies 30 miles this side. The *cost* therefore of constructing the Rail Road to the North Carolina Line may be assumed, at say, three millions, instead of four—the *distance* 120, instead of 150 miles, &c. I will append a note to that effect to the communication to be sent you to-morrow. Respectfully, your friend and servant,

WM. GIBBS McNEIL.

His Excellency Pierce M. Butler, Columbia.

Engineer's Office, L. C. & C. R. R. Co.
Charleston, November 22, 1838.

*To the Governor of South Carolina*—

Sir—The letter from your Excellency, dated the 27th ultimo, was not received until my arrival here a few days since, and my reply to it has been deferred in the expectation that it could be conveyed through the President of the Company, (with whom I was desirous to confer,) but whom, I regret, in consequence of illness in his family, I could not apply to on business. Availing, however, of the brief period prior to the meeting of the Legislature, I have the honor, in reply to your enquiries, to state—

1. That, so far from entertaining a "doubt of the practicability of constructing the proposed Rail Road from Charleston to Lexington and the Ohio River, but especially to the North-Carolina line," the surveys of the past season, and much reflection on my part, have served to confirm me in the opinion expressed at the first annual meeting of the stockholders, at Flat Rock, in 1837, not only of the great feasibility of the project, but the *far greater facility* with which the passage of the Alleghany Mountain, may be effected by the routes within the limits of our surveys, than in any other section of the United States, with which we are acquainted." Several routes surveyed for our Rail Road, connecting the Eastern and Western routes, *through the Carolinas*, are distinguished over all others, "by the great ease with which it enables us. from the Eastern or Southern base of the great chain of mountains, (below which, to the City of Charleston, we all know the favorable character of the country) so to distribute the ascent as gradually to attain the very summit of the Alleghany, or Blue Ridge, at inclinations far within the limits of the advantageous application of locomotive engines, (and without the intervention of a single *in-line* requiring stationary power,) and peculiarly are they so by the extraordinary facility with which the descent Westward is effected from the summit of the Great Alleghany Range, for the distance of 145 miles, or even as far as the City of Knoxville. For our opportunities of information. and the data on which our opinions are founded, I respectfully refer you to the Report of the Chief and Associated Engineers, submitted at the meeting of the Stockholders already alluded to.

2d. "The probable cost of extending the Rail Road from Columbia to the North Carolina line." It will of course depend on the route ultimately selected, and the *plan* on which it shall be concluded to construct the work. But assuming, for the present occasion, the adoption of one of the several practicable routes by which the Rail Road may be extended from Columbia to the North-Carolina line, (a distance of about 150 miles,) and that the road will be constructed *in the most perfect manner*—so as to be efficient and durable (as described in a recent Report which I had the honor to submit at Ashville,) I feel very confident that the *maximum* cost of this portion may be safely assumed at four millions one hundred and twenty-five thousand dollars; or more probably it will not exceed the sum of three millions, seven hundred and fifty thousand dollars.

3. "The shortest time in which the road could be completed to the North-Carolina line, if every facility be provided," will not be less than three years, and need certainly not exceed four years; and as I have on another occasion stated, if vigorous operations be persevered in, I am sanguine in the belief, we should be enabled "to triumph over every obstacle, and even as early as the year 1846, to celebrate the entire completion of this stupendous enterprise, even to the Ohio River." For my further views on this point, I beg leave to refer your Excellency to my last Annual Report to the President of the Company—page 56.

4th. I have not the means at hand, nor does time by any means suffice, to estimate with satisfactory precision, "the probable nett proceeds of the road when finished to the North-Carolina line." It would indeed be difficult, under any circumstances, to determine the ratio of existing trade, and intercourse, and the inevitable increase in these sources of revenue, which invariably attend improved means of transportation, and of intercommunication, by which the resources of a vast and fertile region are to be developed. If we look to the results of internal improvement in other sections of our country—in the States of New-York, Pennsylvania, Ohio, and elsewhere—we find that already they far exceed the most sanguine expectations of the most intelligent projectors and advocates of the system, which is thus strikingly exemplified in the recent and most able report upon the finances and internal improvements of the State of New-York, submitted to its Legislature by Samuel B. Ruggles, Esq. After stating that one of the most distinguished advocates of the system, (Gov. Morris,) "in the singularly eloquent and animated memorial in which he endeavored to enforce upon the Legislature its importance," asked, "whether it would be deemed extravagant to predict that the Canals within twenty years, would annually bring down 250,000 tons?"—Mr. Ruggles proceeds no state; "the actual amount which reached the tide, in 1936, 697,347 tons, or nearly threefold the quantity estimated by Mr. Morris; and the total tonnage of that year, ascending and descending, exceeded *thirteen hundred thousand tons*: and illustrative of the progressive increase of revenue, we are further informed by Mr. R. that "the tolls of the Canals in 1823, one year before their completion, were $340,000. In the next year they reached $566,000, and rose in 1826, to $762,000. The consequences of this enlightened policy of the State of New-York in developing her resources, have proved, instead of the burthen apprehended by some of her first citizens, and as expressed by a distinguished opponent of the system, ("that internal improvement, is but another name for eternal taxation." Mr. Ruggles succinctly states to be that, "the State, within the last twenty years had quadrupled its productive property, relieved its citizens from taxation, and now enjoys a clear annual revenue of nearly eight hundred thousand dollars!" Yet it is doubtlessly apprehended by many, that because *we* are perhaps less favorably situated, we cannot reasonably anticipate similar results—or, in fine, however desirable it may be to improve the *State*, we can scarcely compete successfully, for even a portion of the trade of the great and growing West. On this subject, without obtruding my opinion, I beg leave to point you to weightier authority—that of the United States Board of Engineers, who some years since, in their report, on a connection of the Eastern and Western, (after developing the immense resources of the Eastern and Western States, and the necessity of their having numerous communications with the sea)—remarks, "these States will, therefore, require a certain number of outlets to facilitate the exportation of all these products, and the importation of the returns; and it is doubtful if even four of these outlets will be found practicable between the Juniatta and the Savannah rivers, *even by the combination of Canals and Rail Roads.* Thus instead of fearing that these communications will not be *profitable*, we should rather apprehend that at a future day they will be found insufficent for the passage of the trade between the West and the East."

But, in order to furnish you this by the Express Mail of to-day, that it may reach you in time, I must postpone what I might further add, till I shall have the honor to meet you next week in Columbia. With great respect, I am, Sir, your obedient servant,

(Signed) WM. GIBBS Mc NEILL.

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*Report of a survey of a route for the extension of the Western and Atlantic Railroad.*

OFFICE OF THE W. AND A. RAILROAD,
Cassville, Oct. 15th, 1838.

To the Board of Commissioners of the Western and Atlantic Railroad.

Gentlemen:—In obedience to your instructions, dated on the 11th of July, last a reconnoisance and survey were instituted for the purpose of ascertaining the most favorable route for the extension of the Western and Atlantic Railroad, from the Tennessee line to the easterly margin of the Tennessee river. In order to accomplish these objects in the most effectual and conclusive manner, and with a degree of expedition deemed requisite to their timely performance. Mr. Whitwell was directed to make a careful examination of all routes having any claim to consideration on account of the facilities afforded by them, for the desired extension; and brigades No. 1, and No. 2, the former under the direction of Mr. Brown, and the latter under the direction of Mr. Williams, assistant engineers in the railroad service, were assigned to the execution of all surveys necessary to a clear developement of the relative merits of the several routes in question. In further explanation of the nature and object of the duties assigned those gentlemen, I take leave to refer to the instructions given them, a copy of which, marked E, is appended to this paper.

In accordance with the instructions referred to, the reconnoisance and surveys were recommenced at an early date in August, and prosecuted with energy and ability, and with a direct view to the attainment of all the information called for.

Mr. Whitwell's report on the reconnoisance (see document marked B herewith submitted,) is so lucid and replete with all appropriate intelligence in reference to the aspect of the country, the general position, bearings, and relations of all routes having any claim to consideration, and so conclusive, with respect to the several localities traversed by the route most favorable for an extension of the road from the Tennessee line to the Tennessee river, that I forbear to enlarge upon these topics, (except by signifying my concurrence with the views therein presented.

Agreeably to surveys heretofore made, which have been sufficiently discussed in former reports, the point at which it has been deemed advisable to strike the Tennessee line, is situated in that line at the distance of about eight miles eastwardly of Rossville. Accordingly this point was selected as the place at which the surveys under consideration should be commenced. From this point to the Tennessee river, the following route, in addition to numerous other experimental lines, have been deemed worthy of an instrumental survey, viz: a route leading thence northwardly to Van's Ferry—a route leading westwardly to the mouth of the Chickamaugee, and three routes leading westwardly and southwardly, two of them to Ross' Landing, and the other to Gardenhire's Landing; the distances on which respectively, as measured from the assumed point to the eastern margin of Tennessee river, have been found as follows:

From the Tennessee line to Van's Ferry, the distance is 12 miles, 1320 feet.

From the Tennessee line to the mouth of Chickamaugee, is 12 miles, 422 feet.

From the Tennessee line to Gardenhire's Landing, 14 miles, 3362 feet.

Do. via Kenan's mill, to Ross' Landing, 15 miles, 4632 feet.

Do. via tunnel through Mission Ridge to Ross' Landing, 11 miles, 2720 feet.

The foregoing are the results derived from careful surveys, and exhibits in copious details in the reports of Messrs. Williams & Brown, which I herewith submit, and to which I beg leave respectfully to refer. *(See document marked C and D.)*

The drawings accompanying those documents, which have been executed with a degree of skill, neatness, and precision, highly creditable to the draftsmen employed thereon, exhibit with sufficient clearness the characters of several routes traversed by them, and the relations existing between them and various important points on the Tennessee river, and in its vicinity. To these I also take leave to refer for a correct view of the several subjects just adverted to.

The chart executed under the direction of Mr. Whitwell as an accompaniment of his report, *(see drawing marked E.)* has been prepared from the returns made in reference to the surveys of the Cherokee lands, within the State of Tennessee, and exhibits not only a synoptical view of the several routes surveyed for the railroad, but shows the positions and number of the lots traversed by each route. Special care has been taken to render this document as correct as circumstances would permit, especially in so far as it relates to the route deemed most favorable.

In further explanation of the relative merits of the several routes under consideration, I subjoin the following tabular exhibit in which are presented the designation of each route, beginning at the assumed point on the Tennessee line, viz: a point on the north side, and about midway of Lot No. 5, District 28, and Section 3 of Cherokee land District, in Georgia; the distance on each route from the Tennessee line to the Tennessee river, and the estimated probable cost of constructing a railroad on the several routes respectively, which is as follows:

Beginning at the assumed point and running thence to—

| No. | DISTANCE. Miles, | Feet. | COST. Dolls. | Cts. |
|---|---|---|---|---|
| 1st. Northwardly, to Van's Ferry, | 12 | 1320 | 123,154 | 95 |
| 2d. Westwardly, to mouth of Chickamaugee, | 12 | 422 | 158,623 | 70 |
| 3d. Via Chickamaugee Gap to Gardenhire's, | 14 | 3362 | 192,544 | 50 |
| 4th. Via Chickamaugee direct to Ross' Landing, | 15 | 4632 | 256,503 | 05 |
| 5th. Via Chickamaugee by Detour to Ross' Landing, | 17 | 2913 | 221,245 | 00 |
| 6th. Via Tunnel in Mission Ridge to Ross' Landing. | 11 | 3720 | 654,773 | 05 |

From the foregoing statements, which have been derived from the results presented in the documents already cited, it is manifest that route No. I, leading northwardly to Van's Ferry, is only a few feet longer than route No. 2, and that the cost of construction on the former is very considerably less than on any other route, even less than on the route leading westwardly to the mouth of the Chickamaugee, which is about 300 feet shorter. But in consideration of the pledge implicitly given that the railroad should reach the Tennessee river at a point as low down as practicable, shortness of distance, facility of transportation, and cheapness of construction, being regarded as governing principles of the location; and in view of the obstructions opposed to the navigation of the Tennessee, which occur in that river, between Van's Ferry and the mouth of the Chickamaugee—in consideration of striking the Tennessee at a point most favorable for a prolongation of the route beyond this river, and in a direction towards Nashville, &c., I do not hesitate to recommend the route to the mouth of the Chickamaugee as preferable to that leading to Van's Ferry; while the comparison exhibited in the above table shows its decided preference over every other route presented in the table.

In accordance with the provisions of the laws of Georgia, under which I have acted, in prosecuting the survey and location of the railroad, I have deemed it my duty to designate a point on the eastern margin of the Tennessee, at which the shortest and best route from the Chattahoochee to that river should have its northerly terminus. The trace of the route pursued by the railroad, from the Chattahoochee river to the Tennessee line, which, with the exception of a few deviations, found by subsequent surveys to be advisable, has already been designated in a former report to his Excellency, the late Governor of Georgia, under date of November 7, 1837. The route thus revised and amended, is still regarded as the shortest and best that can be found, leading in an appropriate direction across the broken and diversified region that must be traversed by the railroad. The distance on the revised route from the Chattahoochee to the Tennessee Line, is 115 miles, 147 feet. Accordingly, this distance, added to the extent of route No. 2, which has been deemed as above, the shortest and best route from the Tennessee line to the Tennessee river, gives for the aggregate extent of the shortest and best route from the Chattahoochee to the Tennessee river, 127 miles, 569 feet.

The propriety of designating a single point only, as the northern terminus of the Railroad, is inferred from a literal construction of the laws enacted in reference to the rail road. Whereas the spirit of the law and the exigencies of the case, seem to call, not merely for a point, but for an extensive area or field, for the display of all the abilities, capacities, and energies of the rail road which must hereafter be had in requisition for the accommodation of the diversified and widely extended business transactions that will sooner or later, in all human probability, be concentrated at this place. In such an event, an area of many miles, instead of a single point will be required as the site of the extensive emporium which we have in anticipation, an area which will embrace the entire district, bounded northwardly by the Chickamungee, westwardly by the mission Ridge, and extending downward in the valley of the Tennessee, nearly to Lookout Mountain. In anticipation of such an Emporium, I venture to suggest the method of affording it all the accommodation that will be required, as far as they relate to the Western and Atlantic rail road.

By extending the route onward from the Tennessee line about $9\frac{1}{2}$ miles, which carries on the route selected through the Mission Ridge, we arrive at the point in the valley of the Chickamangee, and near Kenans' mills, from which divergent routes may proceed in various directions, leading to the mouth of the Chickamangee, Gardenhire's Landing, Ross Landing, and to almost every other point on the margin of Tennessee river, between the mouth of the Chickamaugee and Lookout mountain.

The point of divergement above designated, is situated in the route selected, within a few hundred feet of the Chickamangee, is said to be navigable for steamboats in all stages, at which the Tumbling shoals, Lookout and Ross' island shoals, are passable for the same craft. Accordingly, but for the letter of the law, which calls for an extension of the road to the margin of Tennessee river, this point might be assumed as the northern terminus of the railroad. The choice of such a terminus, however, should be predicated on the extension of the several embranchments above contemplated, to the margin of the river, the extent of the branches varying from ten and three-fourths to eight miles, according to the particular points on the river to which they respectively tend.

The following table will exhibit the position, relative extent, and cost of the several routes already surveyed from the point of divergence to the Tennessee river, which are as follows, viz:

Beginning at the point of divergence and running thence to—

| | DISTANCE. | | PROB. COST. | |
|---|---|---|---|---|
| *No.* | *Miles,* | *Feet.* | *Dolls.* | *Cts.* |
| 1st. Mouth of Chickamaugee, | 2 | 3440 | 29,121 | 30 |
| 2d. Gardenhire's Landing, | 5 | 1100 | 62,362 | 75 |
| 3d. Via Deep Cut to Ross' Landing, | 6 | 2370 | 126,760 | 30 |
| 4th. Via Detour to Ross' Landing, | 7 | 4931 | 90,063 | 25 |

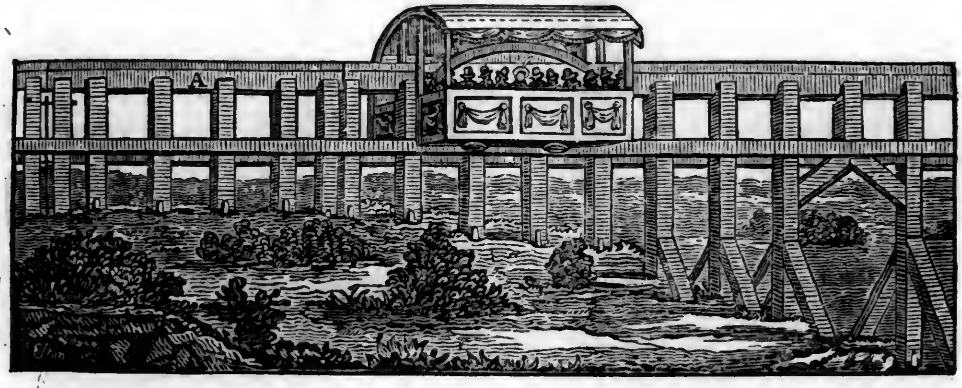
It should be further observed in reference to route No. 1, as exhibited in the above table, that it passes on very favorable ground, and by a remarkably direct course, which it pursues along the margin of the Chickamaugee valley, and in the vicinity of the stream itself quite to the margin of the Tennessee river, which it reaches at an elevation beyond the reach of the highest freshets.

With respect to the business connexions that may be found between the railroad and the Tennessee river, at the several points above designated, as also at numerous other points, both on the bank of the Tennessee and those of the Chickamaugee, conveniences and facilities on a scale commensurate with any demand that may hereafter be made for such accommodations, are undoubtedly to be found I have the honor to be, gentlemen, very respectfully, your most obedient servant,

S. G. Long, Chief Engineer.

For the Railroad Journal and Mechanics' Magazine.

## *A Single Rail Railroad.*



Gentlemen,—I know not what may be your opinion on the subject I am about to offer, but however it may differ from mine, I presume your impartiality will not suffer you to reject a few lines from a subscriber, which, if altogether erroneous, will give an opportunity to abler pens and wiser heads to expose their errors.

I have reference to the plan, a model of which was exhibited at the last fair of the American Institute, of what the exhibitor and proprietor, Mr. Emmons, called a Single Rail Railroad—I was in hopes to have seen it noticed by some one abler than myself to do it justice; but as no one else has yet offered, I venture to hazard my opinion on the subject, which if it is worth nothing, will cost nothing but the reading.

There are, perhaps, few other subjects of deeper interest to the public, at the present time, than that of Railroads, and no enterprize in which more capital is likely to be invested; it is, consequently, of the highest importance to arrive at the perfection of the improvement as early as possible. Its advantages have already marked a new era in the progress of civilization. But it is still attended with some inconveniences, which it would certainly be most desirable to obviate. It is true, the vast expense is no objection, but still economy would dictate to reduce it, if the reduction can be effected, without any sacrifice of its advantages. Its liability to disasters from interruptions placed on the track, either by accident or design, has already been the cause of many serious misfortunes; and the inconveniences arising from snow in the winter in our northern latitudes, are calculated to produce expense and delay.

The plan offered by Mr. Emmons of placing two cars in suspension, balancing each other and a single rail between them, is either practicable and consequently useful, or it is not so; if the affirmative be correct—if there is not some insuperable objection to the plan, then in the first place, it will reduce the expense of construction, which is an object of great importance; in the next place, the elevated situation of the single rail puts it altogether out of the reach of those casualties which are now, and must be under the present mode of construction, of frequent occurrence. And lastly, it will be free from any interruption from snow.

If the negative of the question be true, it must be easy for those who are masters of the subject to show it, and may be fairly considered as a duty which they owe to the public. I make no pretensions to infallibility, but I have been conversant with mechanical subjects during a somewhat protracted life; and I confess, if there is anything impracticable in the plan, I have not the sagacity to discover it.

It is objected that the plan is not new—that it has been tried and rejected; this is in some measure true. A part only of the plan has been tried, and though the original projector may be entitled to the credit of first suggesting the plan, yet his unsuccessful experiment only served to point out the way for further improvements. Those improvements are what Mr. E. claims as original, and they are, in my humble opinion, entirely sufficient to ensure its success if put to practice.

The accompanying cut is given more clearly to illustrate the improvement of Mr. Emmons.

An Old Mechanic.

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## *Probable duration of English Coal Beds.*

In the fifth edition of Mr. Bakewell's *Introduction to Geology*, just published, there are some remarks on the duration of English coal, in addition to the observations made in the former editions of the work, which were quoted in evidence given on the subject in a committee of the House of Commons. After noticing the report of the committee, which estimated the annual consumption of coal in Great Britain at twenty-two millions seven hundred thousand tons, Mr. Bakewell proceeds to observe:

"The increasing demand for coal in the iron furnaces, and for steam carriages, will probably soon raise the quantity of coal annually consumed to thirty millions of tons, without adding to this ten millions of tons for coal left and wasted in the mines. A better idea of the consumption of coal will, perhaps, be formed by stating the quantity of coal burned in the furnaces of one house only (Messrs. Guest, of Myrther Tydvil, in Glamorganshire,) which is 870 tons per day, or 300,000 tons yearly; the amount of iron produced is 50,000 tons This is a larger quantity of iron than was made by all the furnaces of Great Britain and Wales in the year 1760, and exceeds the quantity of iron at present made in Scotland, which in 1827 was only 36,500 tons. Surely when such an immense quantity of coal is required for domestic use and manufactures, it cannot be wise to encourage, or even to admit, the export of coal to foreign parts. The coal so exported, exclusive of that to Ireland and the colonies, is 500,000 tons annually. The duty on exported coal was entirely taken off in 1835, to satisfy the great landed proprietors in the north of England. I have before stated that the coal in Northumberland and Durham would at the present rate of consumption be exhausted in 350 years. An agent of one of the northern proprietors, in his evidence before the House of Commons, extended the duration of the northern coal fields to 1,727 years, estimating that there remained 732 square miles of coal in Northumberland and Durham still unwrought, and that the average thickness of the coal is twelve feet. In this calculation it seems to have been assumed that each workable bed of coal extends under the whole coal field, but many of the best and thickest beds of coal crop out long before they reach the western termination of the coal districts, or are cut off by faults or denudations. Professor Buckland, in his evidence on the subject, estimates the duration of the coal at the present rate of consumption to be 400 years. Professor Sedgwick, who is well acquainted with the coal strata of Northumberland and Durham, and had examined persons of great experience, gave his opinion respecting the duration of the coal in these counties as follows:—' I am myself convinced that with the present increased and increasing demand for coal, 400 years will leave little more than the name of our best coal seams;' and he further adds, 'our northern coal field will probably be on the wane before 300 years have elapsed'"

Mr. Bakewell concludes his remarks on this subject by observing that his former anticipations, that improved methods of burning coal would be discovered, have been realised to a great extent; in proof of which he alludes to statements made at the last meeting of the British Association at Liverpool, of the use of the culm or dry coals of South Wales, by employing the hot blast, in smelting ironstone, which coal it had formerly been attempted to use for that purpose without success. "If," continues Mr. Bakewell, "the use of the hot blast is found everywhere to succeed, the consumption of coal in the iron furnaces will be reduced one-half. It may, however be doubted whether this reduction will equal the increasing demand for coal for steam-vessels and rail-road carriages, and the various manufactures of Great Britain.—*Farmer's Mag.*

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*Number of Patents in France.*—It appears, from authentic documents, that the following number of patents for inventions and improvements was granted in France from the 1st of July, 1791, the period at which they were first accorded, to the 1st of January in this year. The account is divided into the following periods:—During the Constitutional Monarchy, which lasted but three years, 67 patents were granted; during the Republic (fourteen years), 301; during the Empire (eight years) 606; during the Restoration, (sixteen years) 3383; during the Monarchy of July (seven years) 3018; total during the whole period 7375.—*Min. Jour.*

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## *Abstract of Papers read at the Institution of Civil Engineers.*

### "On the Ventilation of Tunnels. By W. West."

This paper contains an account of some experiments on the temperature of the air in a tunnel on the Leeds and Selby Railway. There are three shafts in the tunnel; and Mr. West observes, the temperature of the external air being thirty-four degrees, the temperature at the mouth and as far as the first shaft was thirty-four and a half, but that immediately beyond this shaft it rose to thirty-five degrees, and increased uniformly up to the farther end, at which point it was fifty-seven degrees. From this fact the author infers that the air passed up the shaft, and that the tunnel would be more completely ventilated without any shafts; and that shafts generally are an impediment to perfect ventilation.

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### "Wordsdale's Method of Transferring Letter Bags."

The apparatus invented by Mr. Wordsdale for changing the letter bags on the railways without diminishing the speed at which the carriages are travelling, is exceedingly simple. The bag to be taken up is hung on an arm projecting from a post, generally a lamp post; and the bag to be left is suspended at the end of a rod projecting from the back of the railway carriage. The guard knows the exact distance to which this rod is to be pushed out; and the projecting iron of the lamp-post receives the bag to be left at the same instant that a projecting iron on the guard's rod sweeps off the bag to be taken up. This exchange is certain, and effected without any loss of time.

*Rail Roads.*—General Gaines has kindly furnished us with a diagram of a system of railroads, planned by himself, to extend over the United States. An inspection of the diagram shows Kentucky and Tennessee to be the centre from which railroads branch out to all points of the Union, connecting, for instance, New-Orleans with Portland in Maine; Buffalo and Plattsburgh, in New-York; Detroit, in Michigan; Chicago, in Illinois; Charleston, in South Carolina; Fort Gibson, in Arkansas; St. Louis, in Missouri, and several other points still farther to the Far West. The work, says Gen. Gaines, is designed in time of war, to enable us to wield our fighting men, with their arms and ammunition, for central and middle States to the most vulnerable points of attack on our sea-board and inland border—in one-tenth part of the time and at one-tenth part of the expense, that movements would cost on ordinary roads. It is a work, moreover, rendered indissoluble by its great and imperishable utility to the States and people in general—giving safety to our national independence—encouragement to literature and science—profitable extension to agriculture, and protection to the manufacturing and mechanic arts—thereby tending to make our beloved country prosperous and happy in peace and impregnable in war. This scheme, taken altogether, is grand and sublime, and if carried into effect would make the United States the greatest nation on earth. Success, we say, to the martial patriot and his august plans for the protection and aggrandizement of his country.—*N. O. Bulletin.*

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*Wilmington Road.*—The Wilmington and Halifax Rail Road Company have opened two sections of their rail road, one at the north end, of 13 miles in extent, which brings the road southwardly to Enfield, the other, of 40 miles in length, which carries it to Fairn's Depot, at Goshen, completing thereby, 87 miles of the rail road, and reducing the staging to 90 miles only.—Ten miles more will be finished in November, and 10 in December next, leaving, at the time, but 60 miles of the road to be done.

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*Raleigh and Gaston Road.*—We understand that another section of this Road, eight miles in length, will be opened this week—the termination being at Union Chapel, within four miles of Tar River, and about thirty-five from Raleigh. So soon as the Bridge across Tar River is completed, which will be effected this winter, the residue of the Road will be speedily finished.

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*Our Subscribers* who have so promptly put us in possession of the means of continuing the publication of the Journal, will please accept our thanks. Those who have not yet found the leisure to attend to so small a matter, will please give us, at an early period, some abiding evidence of their desire for the continuance and prosperity of the Journal.

☞ Should any subscriber, *whose subscription remains unpaid*, miss the Railroad Journal, or not receive it as heretofore, he will please *not* attribute its absence to a *suspension of its publication*, but to his own "suspension" of payment *for it.*

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*Errata.*—Owing to the circumstances mentioned in a late number, the following errors crept into the Description of the Philadelphia and Reading Railroad:

Page 252—9 lines from the top, the word "nine" is used instead of "none." The nonsense is so evident, that we presume our readers have made the correction themselves.
" 252—13 lines from the bottom, for "Irvin's Lattice," read "Town's Lattice."
" 252—11 " " for "Queensport Truss," read "Queenspost Truss."